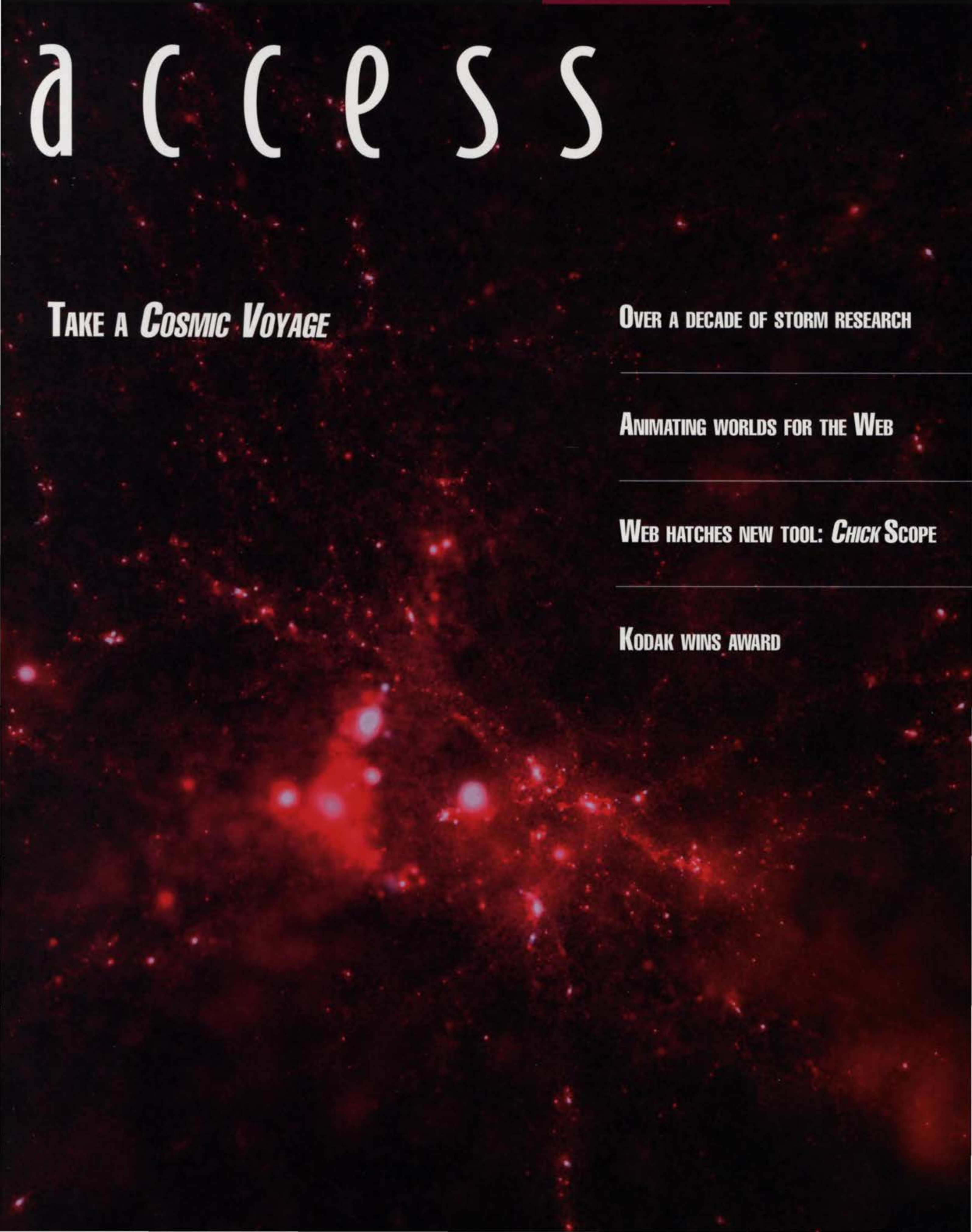
NCSA Vol. 10 No. 2 SUMMER 1996

access



Take a *Cosmic Voyage*

Over a decade of storm research

Animating worlds for the Web

Web hatches new tool: *Chick* Scope

Kodak wins award

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Cover Images: Frames from the IMAX film *Cosmic Voyage*. © Smithsonian Institution & Motorola Foundation.

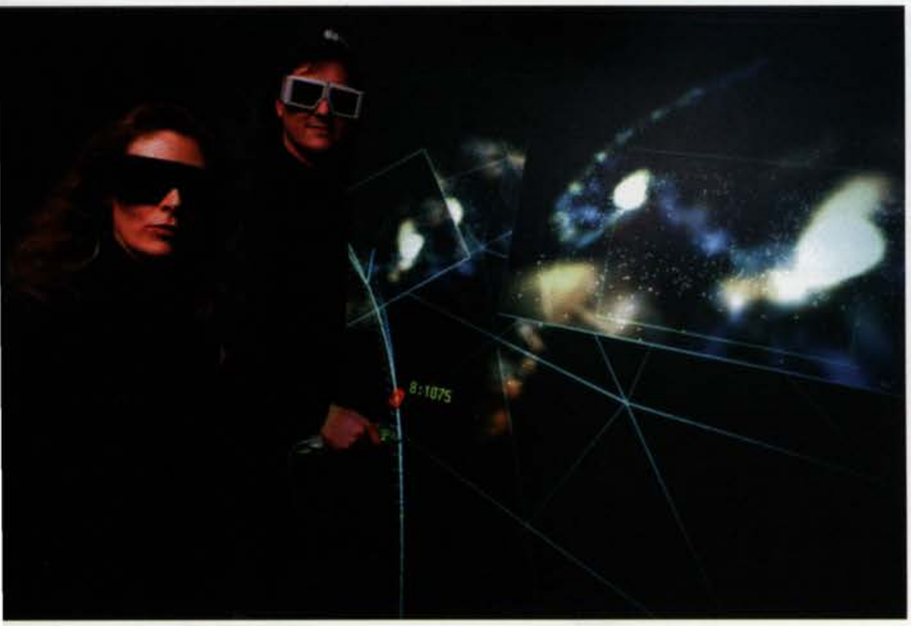
NCSA

A TEN-YEAR FOUNDATION FOR THE FUTURE
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Astrophysical Simulations Come Alive in a *Cosmic Voyage*

by Sara Latta

Cosmic Voyage, a new IMAX film scheduled to debut at the Smithsonian National Air and Space Museum in August, is typical of IMAX films in the feeling of sensory immersion it creates in its viewers. But the technology of its production is unique.



Reproduced by permission of *The Champaign-Urbana News-Gazette*; photo by Francis Gardler

Donna Cox, left, and Bob Patterson view a colliding-galaxies simulation inside the CAVE.

A sweeping journey through space and time, the film carries viewers from the largest structures in the known universe down to subatomic quarks; from the first few seconds after the big bang to the present day.

Cosmic Voyage is one of the first IMAX films to use supercomputing simulations and the first IMAX film ever to use four minutes of research-quality scientific visualization. The four-minute segment, which begins shortly after the big bang, shows the expansion of the universe, the gravitational collapse of structure and the formation of galaxies, and the collision of two spiral galaxies. It was a result of the collaborative efforts of NCSA scientific visualization experts, scientists in the Grand Challenge Cosmology Consortium (GC^3), two movie production companies, and numerous high-performance computing machines at multiple centers. While the film's primary goal is to entertain and educate, those four minutes yielded unexpected scientific insights and spurred the development of new scientific visualization technology.

At the heart of the collaboration is Donna Cox, UIUC professor of art and design and principal investigator of NCSA's Renaissance Experimental Laboratory. Cox, the associate producer for scientific visualization for *Cosmic Voyage* and the art director for the four-minute simulation segment, was involved in every step of the film's production—from the conceptual and fund-raising stage to consulting on the finishing touches.







Images from a galaxy-collision sequence in the Smithsonian's IMAX movie. The galaxies merge over a billion years to form a single massive structure.

From science to art—and back again

The first scene of the four-minute sequence depicts the expansion and evolution of a nearly homogeneous universe a fraction of a second after the big bang, to the era called *recombination*, when protons and electrons combine to form hydrogen atoms and when photons part company with matter.

This scene uses an algorithm (written by Greg Bryan, a graduate student working in the laboratory of UIUC Astronomy Professor and NCSA Senior Research Scientist Michael Norman) based on the Harrison-Zel'dovich spectrum describing the density fluctuations in the early universe. Pixar, the movie production company famous for creating *Toy Story*, ran the simulation and created the visualization for this sequence.

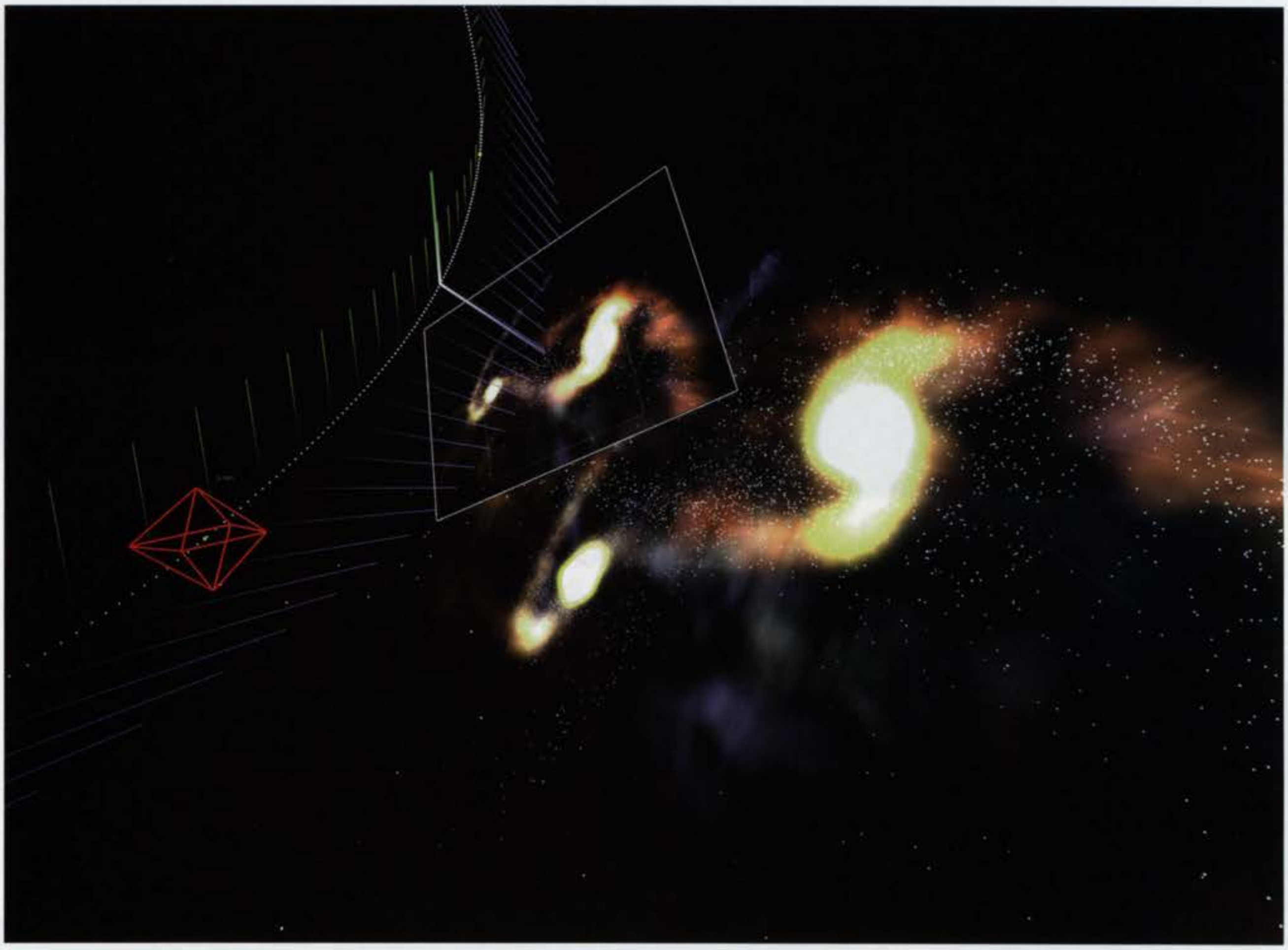
The first scene segues into the hierarchical collapse of structure, starting with a large-scale overview showing the early formation of web-like filaments, then traveling along a filament to show the formation of galaxies along knots in the filaments. The scene concludes with a cluster of galaxies forming at the intersection of filaments.

This scene, which lasts 70 seconds, is based on a simulation run by Frank Summers, a postdoctoral researcher in astronomy at Princeton University and member of the GC^3. The simulation follows the evolution of 2.1 million dark matter particles and 2.1 million gas particles. Pixar, which was consumed with *Toy Story*, lacked the disk space, the networks, the human resources, and the computing power to deal with this and the following simulation. "This project moved from a Hollywood production to a major supercomputer/mass storage challenge," says Cox, who assumed responsibility for coordinating the simulations and visualizations for the subsequent scenes. "NCSA's POWER CHALLENGEarray, high-speed networks, and mass storage provided the resources to tackle the challenge."

Each IMAX motion-picture frame is about 10 times the area of a standard frame of 35-millimeter (mm) film. Because of this, creating images for the giant IMAX screen demands simulations of unprecedented resolution. In Summers' case the resolution had to be 10 times greater than anything he had done previously. In turn NCSA produced extremely high-resolution images from the data, at 4,096 x 3,002 pixels.

NCSA allowed Summers to use one of its (then) new SGI POWER CHALLENGE machines to run the calculations. "I basically ran it full out, using all eight processors, for a solid month," says Summers. The result: 120 gigabytes of remarkable data. "A cluster of galaxies has internal gas," explains Summers. "When a galaxy, composed of both gas and stars, falls into a cluster, the hot gas [of the cluster] interacts with and strips the gas from the galaxy—something we call RAM-pressure stripping. When I looked at the data, the amount of RAM-pressure stripping was much greater than I had previously suspected. There were long streamers of gas trailing behind these galaxies that had fallen into the cluster."

The final 1 minute and 50 seconds of the sequence—the collision and the merging of two spiral galaxies—is based on a simulation carried out by Chris Mihos and Lars Hernquist of the University of California, Santa Cruz, on San Diego Supercomputer Center's CRAY C90 system. (Mihos is now a Hubble Fellow at Johns Hopkins University.) The scientists modeled the gravitational interplay of 250,000 particles representing galaxies by making local estimates of the pressure, density, and temperature of interstellar gas.



Donna Cox, NCSA/UIUC; Bob Patterson, NCSA; Marcus Thiébaux, EVL/UIC © University of Illinois

The virtual camera and its path is shown in the 3D space of two colliding galaxies. This view is created from a secondary virtual camera inside the CAVE with Thiébaux's Virtual Director renderer.

Achieving the exact degree of resolution required 750 CPU hours to compute and generated 65 gigabytes of raw data that were then transferred to NCSA for visualization.

As the galaxies merge and then draw apart, tidal forces and galactic rotation cause the galaxies to cast off stars and gas in the form of long, thin "tidal tails." The compression of interstellar gas into the merged galaxies fuels an intense burst of star formation. Like Summers, Mihos and Hernquist found that increasing the resolution of their simulation led to new science, ". . . particularly," said Mihos, "the large number of small, condensing gas clouds in the colliding galaxies that could be related to the formation of young, luminous star clusters or small dwarf galaxies, which are seen in many observed galaxy collisions."

Data into pictures

Erik Wesselak, NCSA programmer, wrote an interface between the simulation data and a custom particle renderer—the Star Renderer—developed by Pixar Senior Scientist Loren Carpenter. Cox and Robert Patterson, visualization and virtual environment designer at NCSA, designed the aesthetics of the visualization using some 30 interface parameters, including color and transparency. The Star Renderer ran on NCSA's POWER CHALLENGEarray to compute over 100 gigabytes of high resolution imagery. Barry Sanders, NCSA technical assistant, managed those gigabytes of data over the network and mass store.

To create the camera moves through the simulations, Cox worked with Patterson, the choreographer of the sequence, and Marcus Thiébaux, the virtual environment research programmer at UIC's Electronic Visualization Laboratory, to create a voice-driven CAVE application called the Virtual Director (see opposite page), a virtual reality method for directing the computer graphics camera for real-time playback or animation recording. The team made numerous videotapes, aiming for just the right trajectory here or the most revealing angle there.

Finally the choreographed and rendered images were sent to Santa Barbara Studios in California where they were recorded to 70 mm IMAX film. Santa Barbara Studios also created another 10 minutes of special effects, scientific illustrations (including a "snapshot" of one of Norman's simulations illustrating large-scale structure), and Jet Propulsion Laboratory-mapped data. "Fourteen minutes of 4,096 x 3,002 pixels-per-frame, high-resolution IMAX computer graphics is unheard of in the industry," says Cox.

"There were many meetings at the Smithsonian to get everything approved," notes Cox. "The Smithsonian's Science Advisory Committee—including a number of Nobel Laureates and other science experts including GC[3] members—scrutinized each segment."

The beginnings

Cox actually started working on the *Cosmic Voyage* project in 1992, when the film's producer, Jeff Marvin, and director, Bayley Silleck, asked her to make a test video demonstrating NCSA's ability to produce a scientific visualization suitable for the IMAX format. Cox, Patterson, and Mike McNeill (former NCSA research programmer) worked with UIUC Associate Professor of Physics and Astronomy Susan Lamb and Richard Gerber, then a graduate student in her lab, to create a test video of two colliding galaxies. Although their simulation was ultimately not chosen by the Smithsonian for inclusion, the video helped get the project funded. NCSA's industrial partner Motorola was sufficiently impressed by the data-driven potential of the film to help fund the project. (*Cosmic Voyage* is also funded by the Smithsonian National Air and Space Museum and NSF.)

Following its premiere at the Smithsonian Air and Space Museum this summer, *Cosmic Voyage* will travel to over 150 IMAX and OMNIMAX theaters around the world. ●

Sara Latta is a freelance science writer.

Creating Computer Graphics Choreography with Virtual Director

by Sara Latta

Creators of cinematic special effects know that choreographing the camera's movements through computer animations requires hours of laborious keystrokes and clicks and drags of the mouse. Robert Patterson, Donna Cox, and Marcus Thiébaux, creators of the camera choreography software used in making *Cosmic Voyage*, knew there had to be a better way.

Their solution was a user friendly yet sophisticated tool called Virtual Director—conceived and designed by Cox and Patterson, with Thiébaux designing and writing the software program—that would allow the choreographer to use voice commands and a hand-held wand to control the camera's movements in a 3D stereo environment such as the CAVE.

In choreographing *Cosmic Voyage*, Patterson used sampled-down versions of the original datasets to achieve real-time responses in the CAVE. An image of the virtual camera and the path it travels in the CAVE is displayed in stereo 3D along with the simulations. "You're actually controlling the position of the camera by moving a wand in 3D space, instead of clicking and dragging the mouse," says Patterson. "It's an intuitive, interactive method of placing camera key frames to build up a spline through space and time."

The *spline* is a curve containing points that control the direction of that curve. "What's different about this spline," Cox explains, "is that it's a three-dimensional curve. . . . This spline represents the motion of the camera through the dataset, through the CAVE." Each camera point in the spline contains six degrees of freedom—three for rotation and three for position. Traditional tools required the choreographer to manually create the position of each point. "Ten thousand clicks and drags later, you've got something," says Patterson. "Here you can see everything in a stereo 3D environment. I can move points along the spline to wonderful new positions with the wand, say 'take it,' and voilà! In real time the computer refits the spline to the new data points, and I can play back the new camera moves through the dataset."



© Smithsonian Institution & Motorola Foundation

Galaxies in the early universe form like water droplets on filaments of condensing gas. This sequence was choreographed using Virtual Director.

The output of the camera is displayed on a section of a CAVE wall. Navigation mode provides a free-form method of flying through and around the data, searching for the best perspectives to place camera key frames. In the navigation mode, Patterson uses a hand-held wand to control the viewer's rotation and position with respect to the 3D simulation. "Most programs would give you a simulation on a computer screen and allow you to rotate that simulation on the screen," says Cox. "Here you can actually rotate our immersive environment around that 3D space." Adds Patterson: "It's a great tool for scientific analysis as well as for creating a spline that can document for others what you found."

Patterson and Cox believe Virtual Director could be of great use to the commercial film industry. "People in the production industry could use this to do previsualization of a live action scene for the next day," says Patterson. "Or a director could stand inside the CAVE, direct motion-capture artists outside, and see their digital representations composited into a virtual set." ●

Virtual Director software http://www.ncsa.uiuc.edu/EVL/docs/VROOM/HTML/PROJECTS/48Thiebaux.html

Cosmological structure formation in the IMAX film *Cosmic Voyage* http://zeus.ncsa.uiuc.edu:8080/Summers/IMAX.html

The Ups and Downdrafts of Simulating Tornadoes

Rhonda Anderson



Interview with Robert Wilhelmson

Severe storm simulations have changed a lot in 11 years, in large part due to the work of Robert Wilhelmson's storm research group.

by Holly Korab

On a chill February day in San Francisco, Robert Wilhelmson was feeling the warm glow of success. A postdoctoral research associate from his group, Bruce Lee, was showing the group's latest storm animation to a crowd of more than 200 experts on severe storms at the 1996 biennial severe storms conference.

Usually that crowd is difficult to impress, but Lee had captured its attention with the first high-resolution rendering of landspout tornadoes. These lesser-known cousins of supercell tornadoes are of interest to meteorologists now that housing subdivisions are dotting the landspout-prone Florida peninsula and the plains of northeastern Colorado. Landspout tornadoes are not as violent as supercell tornadoes, but their cumulative toll can be as great. People have witnessed as many as six funnels emerging simultaneously from a rapidly growing line of thunderstorms before weaving destructive paths several hundred meters wide and over 10 kilometers in length.

What impressed the experts during the five-minute animation wasn't just the striking imagery but also the resolution. In capturing the dynamics of these storms, Lee and Wilhelmson had developed a computer code for NCSA's CM-5 system that resolved the entire storm dynamics on a 60-meter horizontal grid (one data point every 60 meters over 10 kilometers). That resolution is almost twice as fine as the grids most often used for modeling tornadic circulations in severe storms. Severe storms—thunderstorms, tornadoes, squalls—are usually modeled on 3D grids on which partial differential equations for winds, temperature, pressure, moisture, and water are solved. In the landspout simulation, equations are updated every 0.4 seconds for just under an hour, resulting in billions of numbers.

Equally impressive were the massive numbers of particles modeled. Wilhelmson and Lee identified the air flow patterns within the tornadoes and storms by tracing the trajectories of some 6,500 particles. Other animations had used 50 particles, sometimes 100. Here were 65 times as many.

When Lee's talk ended, hands shot up around the room. Wilhelmson and his research group had another hit on their hands.

Storms through the years

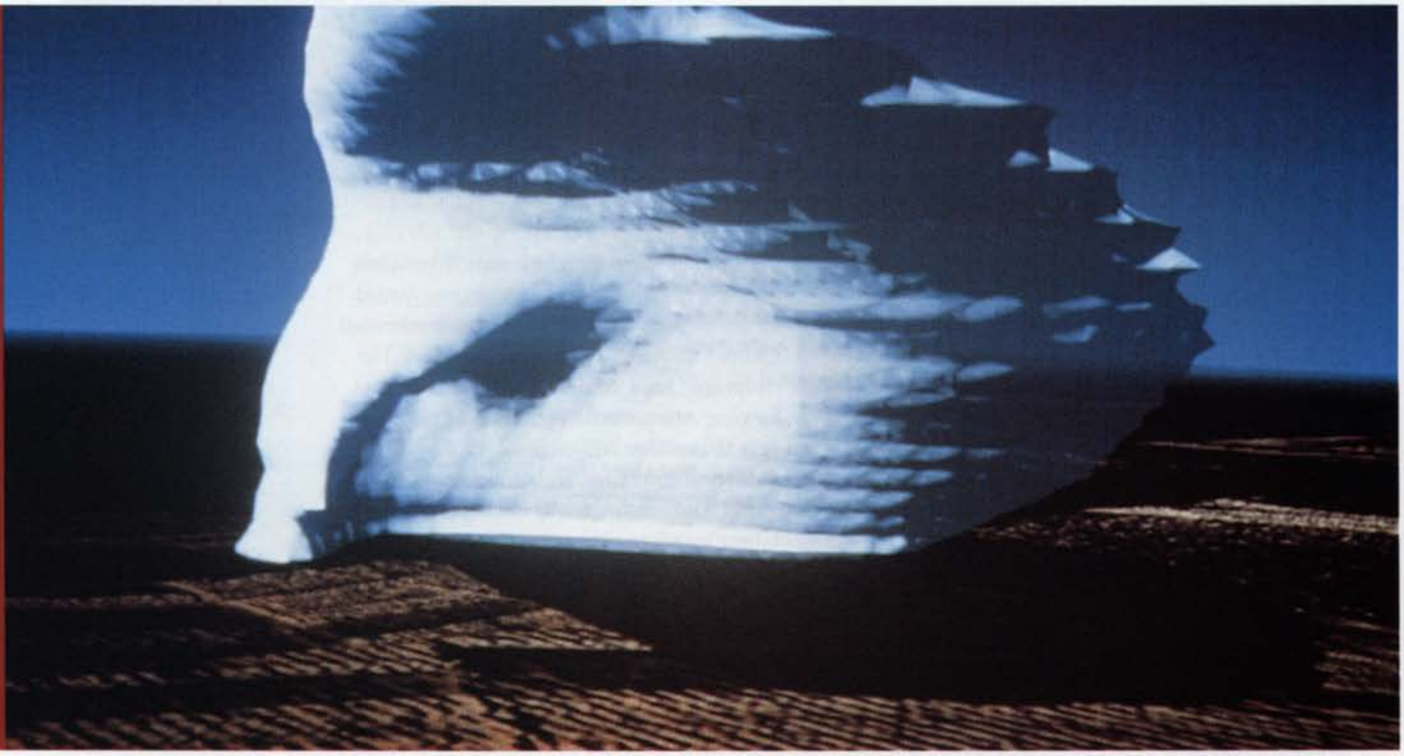
Producing "hits" was not why Wilhelmson began modeling storms 27 years ago. This atmospheric computer scientist wanted to better predict severe storm phenomena like the 30 tornadoes that ripped through Illinois on April 19, 1996. The tornado that flattened the central Illinois town of Ogden left 350 of its 800 residents homeless. That only one person died—compared to 700 dead after a tornado of similar duration and intensity struck Illinois in 1925—is due, in part, to improved forecasting.

Saving lives and property is one of the reasons why Wilhelmson models storms, but his innovations have led to a string of firsts in storm visualization. In 1989 he and his NCSA colleagues produced a severe storm animation that won 14 awards and is regarded as a classic in scientific visualization. In 1995 his research team's visualization of a tornado evolving from a thunderstorm appeared in the OMNIMAX film *Stormchasers,* seen by an estimated 15 million people. In 1996 they simulated landspouts. Wilhelmson was already well-known in scientific circles for his computational achievements—such as the landmark 1978 storm convection model he wrote with Joseph Klemp at the National Center for Atmospheric Research—but he has won wider acclaim with his visualizations.

When Wilhelmson helped found NCSA in 1985, his goal was to model the evolutionary nature of storm. Animation and real-time interactions with storm data—none of which was then possible—followed. In the last 11 years, he and his storm research group have pushed storm visualizations from static 2D and 3D images, to 2D animations, to 3D renderings of simulations in real time at greater resolution and longer time spans. Today they are exploring immersive simulations in virtual reality. They have pushed the limits of visualization, both to improve its graphical and communicative qualities and to build new tools for scientific explorations.

Here are highlights from those eventful 11 years.

1987



Courtesy Robert Wilhelmson

The first storm cloud

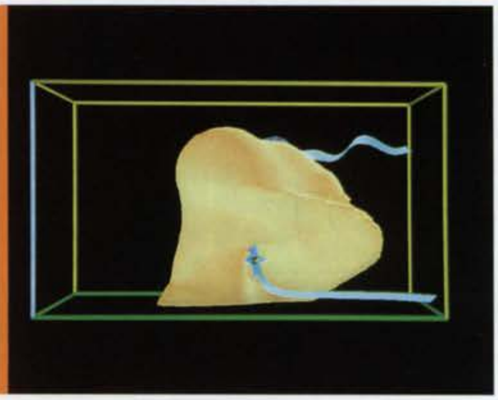
Never one to think small, Wilhelmson's first venture at NCSA was to collaborate with the center's then pioneering Visualization Group to produce the first rendered 3D animation of a severe storm, which was released in 1987. The animation was modeled on a violent thunderstorm that swept through central Oklahoma on May 20, 1977, producing a tornado.

This seminal animation traced a small cloud's growth into a thunderhead. The evolution was computed using time-dependent equations solved over the storm region at grid points spaced 500 to 1,000 meters apart. By today's standards that resolution is coarse—certainly too large to capture the elusive changes in air flow that transform a storm into a tornado. In 1987 that was not an issue. It would be several years before computing speed and memory increased sufficiently to contemplate modeling a tornado together with its parent storm.

Data that flows like a river

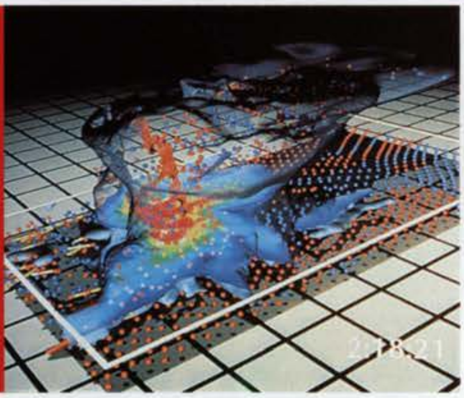
NCSA's first major step toward 3D, real-time visualization came a year later. In 1988 a team that included Wilhelmson, led by Robert Haber (UIUC professor of theoretical and applied mechanics and then also adjunct faculty at NCSA), began experimenting with real-time rendering and distributed computing through a far-reaching project called RIVERS (Research on Interactive Visual EnviRonmentS).

1988



The RIVERS group produced a system for rendering 3D images at rates of up to 30 frames per second at low resolution. The equivalent of videotape, this rate is considered real time. Group members also wrote prototype software for interactive visualization, such as for calculating a storm flow trajectory in real time. Their most significant contribution, however, was a schema for computing across platforms and on architectures ranging from workstations to supercomputers. This precursor to distributed computing was demonstrated by Haber and Wilhelmson at SIGGRAPH '89 when the team hooked up a satellite dish behind NCSA to broadcast a live interview, data, and images to the convention in Boston. Data and images were displayed on a graphics workstation and projected onto a large screen.

1989



A classic is born

Also debuting at SIGGRAPH '89 was a video of an evolving thunderstorm that became a classic in visualization. With its dance-like sequences and vivid graphics, *Study of a Numerically Modeled Severe Storm* changed scientists' perceptions of visualization.

The video, which later won 14 awards and was nominated for an Academy Award for animation, was of a storm that pummeled Oklahoma and Texas on April 3, 1964. The storm split near Wichita Falls, TX, later forming a tornado that injured 111 people and caused $15 million in damage. The animation took a year to produce and employed many sophisticated visualization techniques such as 3D surface rendering combined with 2D slices of the evolving storm. Red and blue ribbons and white spheres wound through the storm, tracing the movement of air currents. Twisting ribbons represented storm rotation; growing ribbons represented updrafts and downdrafts; the spheres showed the movement of weightless tracer particles.

The video's breakthrough was graphic, not scientific. Most of the scientific relationships shown in the animation were well known, though it did confirm several characteristics of air flow. Wilhelmson credits it with helping awaken the scientific world to the potential of computer animation. "It demonstrated a marriage between science and visualization capabilities and techniques that had been developed for other purposes." Or, says Larry Smarr, director of NCSA, "It coupled the scientific community with Hollywood."

PATHFINDER

Real-time animation was the next push for Wilhelmson's research team. Building on the distributed computing concepts explored in RIVERS—and with funding from NASA—the team, together with a group from NASA Goddard Space Flight Center, initiated PATHFINDER (Probing ATmospHeric Flows in an INteractive and Distributed EnviRonment) in 1992.

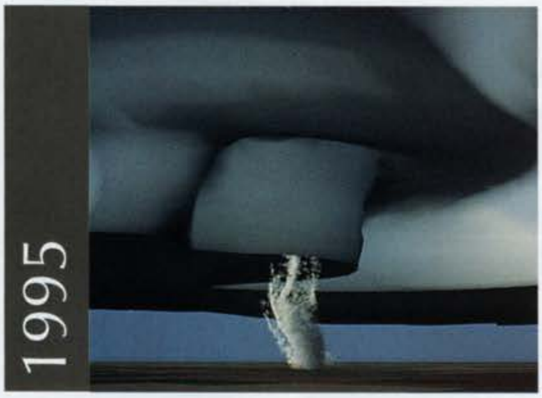
1992



PATHFINDER was a prototype of today's visualization system for scientists. It placed tools on their workstations for quickly producing 3D images and animations like those in the numerical thunderstorm video. "It took scientists from the place where 3D animation was something so complicated they could only do it once a year to something they could do in a matter of days," says David Wojtowicz Jr., a systems manager in UIUC's Department of Atmospheric Sciences who then was a research programmer for NCSA.

Images courtesy Robert Wilhelmson

At the core of PATHFINDER was SGI's IRIS Explorer, a distributed software system for viewing 3D data. It consists of a string of modules (software building blocks) for data reading, filtering, geometry, rendering, and display. The PATHFINDER team worked closely with SGI to augment this system for Earth scientists by adding modules for contouring and more sophisticated capabilities for reading NCSA-developed Hierarchical Data Format files. A feature of PATHFINDER—with Wilhelmson's fingerprints on it—was a separate package for particle advection that was coupled with the rendering of an evolving storm. PATHFINDER software was demonstrated at SIGGRAPH '92, where the output from a storm was displayed on a workstation screen in the Showcase event in Chicago as quickly as the CRAY-2 supercomputer at NCSA solved the equations.

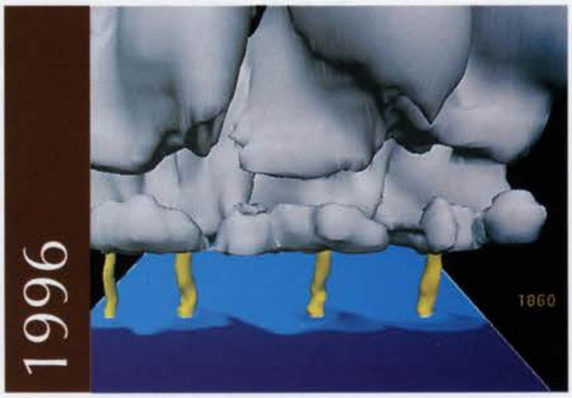


Storms that fill an auditorium

Atmospheric scientists will remember the tornado sequence in the 1995 OMNIMAX film *Stormchasers* as the first animation of both a supercell thunderstorm and the tornado it spawned. The 90-second animation captured the evolution of the storm, then zoomed in on the lower portion where the tornado formed. The twister's violent updrafts and downdrafts were traced by 20,000 particles with some released and removed from the simulation every second.

The storm simulation used COMMAS—a code for nonhydrostatic nested grids—written by one of Wilhelmson's former postdoctoral research assistants, Lou Wicker, who now is an assistant professor of meteorology at Texas A&M University. Both the storm and the tornado were resolved on grids with 1,800-, 600-, and 200-meter horizontal resolution to reduce computer time and data storage. As it was, the animation required 40 gigabytes of data—about four times more than in the 1989 project. "This couldn't have been done 10 years ago," says Wilhelmson. "It has only been in the last five or six years that the computing power and modeling technology have been good enough for us to simulate both the storm and the tornado it produces."

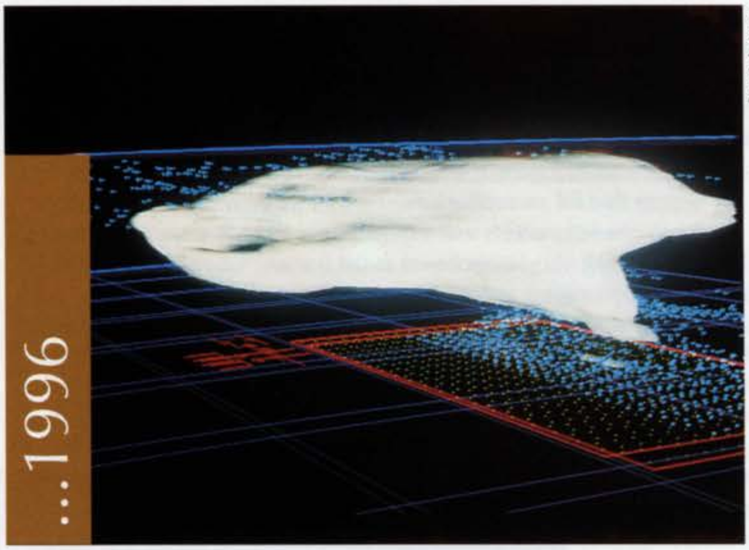
Landspouts



Whereas the nested grid was a key factor in executing the OMNIMAX simulation, its elimination was one of the major features in the landspout simulation. Lee exploited the computational muscle of massively parallel CM-5 architecture to offer greater detail throughout the whole simulation and to eliminate the numerical and logistical complications associated with passing information across nested grid boundaries. The landspout's computational domain, with a 60-meter horizontal grid resolution, represented an area 23 km long by 11.5 km wide by 14 km high, with 3.6 million grid points updated every 0.4 of a second.

"I think this is what the future holds," says Wilhelmson. "Within 20 to 25 years, the National Weather Service will cover the entire globe with a fixed high-resolution grid."

Images courtesy Bruce Lee



Storms in virtual reality

Virtual reality (VR) is Wilhelmson's next visualization frontier. When asked why, he tells this story:

Last fall, immersed in a tropical squall simulation while experimenting with a new particle trajectory tool in NCSA's CAVE, Wilhelmson discovered a structure he had never before seen in the animation. As he brought the squall line away from the wall and in front of his face, he noticed a sheet of particles behaving like a rear inflow jet. Other phenomena appeared more chaotic than expected. Why the differences? One reason was the immersive nature of VR—data surrounds you. Another, says Wilhelmson, was real-time interactivity. "The tools developed for animation let you move forward and backward. As we use this interactive, 3D software environment, we can change the parameters and produce a different output."

Real-time storm VR made its public debut in December at Supercomputing '95. Wilhelmson's team simplified the OMNIMAX trajectory calculations so that they could run in real time by reducing the number of particle trajectories to between 1,000 and 2,000 and by assuming that the velocity data did not vary in time. Despite the compromises, it was another first for severe storm simulations.

Weather on the Web

The World Wide Web, too, will have a role in storm visualization. Already weather sites have found a niche on the Web. Increasingly these sites are incorporating many of the same tools and data used by scientists. The Web also serves as a venue for sharing research. That was the Internet's original role, but Wilhelmson says that the Web will be more dynamic. "Some researchers are already keeping lab diaries on the Web," says Wilhelmson. "They've got animations and 3D tools. With the Web even animations can be submitted for peer review."

What Wilhelmson finds most exciting about the Web is that many of the tools being developed for this medium have dual purposes—they inform the public and enrich science. Eleven years ago these two goals of visualization were pursued separately; now they are melding. One example is the new Java-aware Weather Visualizer (see page opposite) recently developed at UIUC's Department of Atmospheric Sciences and NCSA. Says Wilhelmson, "It shows how important visualization technology is becoming to both the scientific world and the public." ●

Holly Korab is a science writer in the NCSA Publications Group.

Atmospheric and Oceanic Science http://redrock.ncsa.uiuc.edu/AOS/home.html

Contributors to Storm Simulations and Visualizations at NCSA

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- Chris Song
- Jerry Straka
- Danesh Tafti
- Jeff Terstriep
- Jeffrey Thingvold
- Craig Upson
- Louis Wicker
- Robert Wilhelmson
- David Wojtowicz Jr.
- Jeffery Yost
- Guangming Zhou

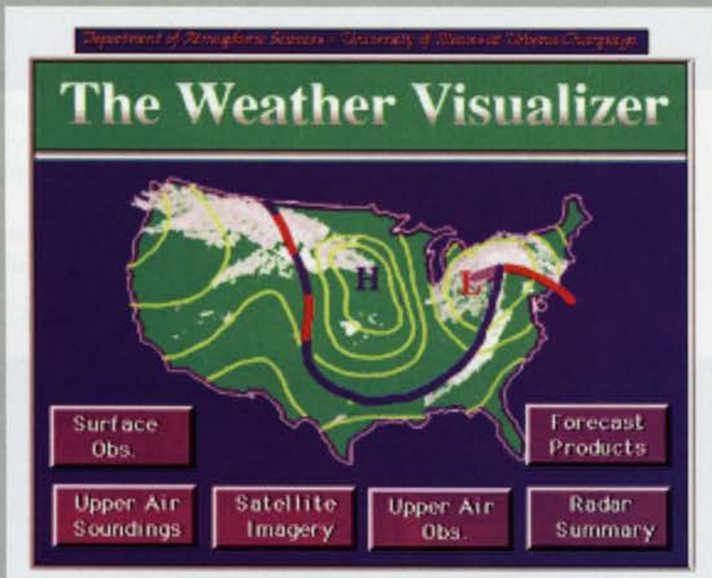
Real Weather on the Web

No more canned weather data. For the real thing, check out Weather Visualizer.

by Holly Korab

Maybe you can't control the weather, but now you *can* control the weather map.

A new visualization tool called Weather Visualizer lets you create customized weather maps on the Web with real-time or archived data. You can follow an evolving storm anywhere in the U.S. or find out if it's raining in Des Moines. It's like having a weather station on your desktop.



"Weather Visualizer is one of the very few sites on the Internet where you can tailor a product to your needs and then interact with that product," says Mohan Ramamurthy, UIUC associate professor of atmospheric sciences. He and NCSA's Robert Wilhelmson, who is also a professor of atmospheric sciences, worked with atmospheric sciences students and programmers to develop the tool.

At the heart of Weather Visualizer is point-and-click technology for creating the six most common categories of weather maps: surface observations, upper air observations, upper air soundings, satellite imagery, radar summaries, and forecast data. Click on the icon for one of these maps and a form pops up displaying the available options. The form linked to the satellite image icon, for instance, offers a selection of image types—visible, infrared, water vapor, or color-enhanced infrared—as well as a yes-no option for a radar summary overlay. Choose among 10 geographic regions and recent or archived observations. When done click *Submit Query*, which sends a request to the server to collect the necessary data and compute the map. To change the map, select different options and resubmit the query.

Anyone puzzled by a term or symbol can click on *Helper Pages* for an explanation. The more inquisitive can explore the extensive *An Online Guide to Meteorology*. Discover the differences between the four types of severe storms as well as the one most likely to erupt into a tornado. These informational extras divulge Weather Visualizer's genesis as a tool for education. It was developed with NSF support through the Collaborative Visualization (CoVis) Project, a joint endeavor among Northwestern University, UIUC, and the Exploratorium Museum in San Francisco to create K–12 science curriculum for the Web. At UIUC it is coordinated by Steve Hall.

CoVis methods are modeled after scientific collaboration practices and draw upon many of the same tools and data. For Weather Visualizer, data streams in from sources such as the National Weather Service (NWS). Every hour NWS compiles the observations from approximately 1,700 observing stations and transmits them via commercial and nonprofit data vendors to UIUC. Eventually some of the vast amount of data compiled daily by NASA's Earth Observing System will be accessible through the Visualizer. Easy access to this impressive array of data has convinced more than 40 schools to use Weather Visualizer and has won fans among meteorologists, airline pilots, farmers, and weather junkies of every ilk.

Java promises greater interactivity

In January Joel Plutchak and Vladimir Tokarskiy, UIUC Department of Atmospheric Sciences research programmers, released the experimental Java version of the Visualizer. It promises greater interactivity as well as faster response time. "It has everything you see on the TV weather and more, " says Plutchak, who wrote most of the code.

Support for this effort also comes from NASA's Project Horizon (centered at NCSA) because that project is also interested in Web scalability issues like those faced by Weather Visualizer. The popularity of the Visualizer has been pushing the server into overload as it struggles to keep pace with requests for the compute-intensive maps. Java may relieve the strain by transmitting small chunks of program, called applets, along with the data so that maps are compiled on the user's computer rather than on the server. The client's computer does not interact with the server again until the client downloads new data.

The snazzy new Java features include graphically displayed pop-up temperature forecast data for point-and-click map locations selected by the user as well as customized map animation. Users can select the specific frames they want to animate, then advance or rewind the maps step-by-step or select an animation speed. More applets are in the works for zooming and map analysis. According to Hall, the CoVis coordinator, "It is all part of our goal of giving the user total control over the weather map." ●

Project Horizon http://www.atmos.uiuc.edu/horizon

CoVis http://covis.atmos.uiuc.edu/covis/visualizer

Discovery at UI May Extend Life of Chips

University of Illinois researchers have discovered what could be a "fountain of youth" for computer microchips.

by Jodi Heckel

Two professors of electrical and computer engineering have discovered a new way to process silicon microchips that will extend the life of the chip and allow it to be driven faster and perform better.

The impact on the electronics industry could be tremendous if private industry adopts the new technology, researchers say. Silicon chips are found in most electronic devices—everything from kitchen appliances and automobiles to equipment used in space.

A news conference announcing the discovery was held February 14, 1996, at UIUC's Beckman Institute for Advanced Science and Technology.

Karl Hess and Joseph Lyding are both conducting research at Beckman on *nanotechnology*, or the science of making ever-smaller electronic devices.

Lyding was studying the modification of silicon surfaces that are used in transistors in microchips.

In his research, Lyding removed hydrogen from a silicon surface and replaced it with deuterium, an isotope of hydrogen. An *isotope* is any of two or more forms of an element with the same atomic number but with different weights.

When Lyding tried to remove the deuterium from the silicon, he found it was 100 times as difficult to remove as the hydrogen.

"Even though it is chemically almost identical to hydrogen, it has certain physical properties—it is twice as heavy as hydrogen—that made it very difficult to move," Lyding said.

Hess suggested to Lyding that his discovery was relevant to the microchip industry. "I have to think about future research directions, and I realized materials [Lyding] was dealing with were directly relevant to transistors," Hess said.

Lyding said transistors in a computer chip function as on-off switches to pass information through the chip. Transistors are made up of various layers of insulators, metals and semiconductors. In a transistor, the interface between materials is essential to how well the transistor works. That interface is treated with hydrogen to neutralize imperfections in the materials and improve the transistor's performance.

"During the operation of the transistor, very energetic electrons moving near the interface can cause hydrogen atoms to be knocked off. This restores the imperfections that were there, and the performance of the transistor degrades and causes problems," Lyding said.

Lyding said the discovery that deuterium was more durable than hydrogen was totally unexpected. Hydrogen has been used for about 25 years in treating microchips.

Lyding said transistors usually last between five and 10 years, and there is a trade-off between how long they will last and how well they will perform. By improving the chip, it can be driven harder and faster and still last five to 10 years, so the user will get more performance from it.

Hess contacted Isik C. Kizilyalli, who received a doctorate in electrical engineering at UIUC, about testing the process on circuits actually used in microchips.

Kizilyalli, a research engineer and an expert on transistor physics and reliability at AT&T Bell Laboratories, provided the chips and performed accelerated aging tests on them after Lyding and Hess treated them with deuterium. The experiments Kizilyalli conducted found that treating transistors with deuterium extended their lifetime between five and 50 times.

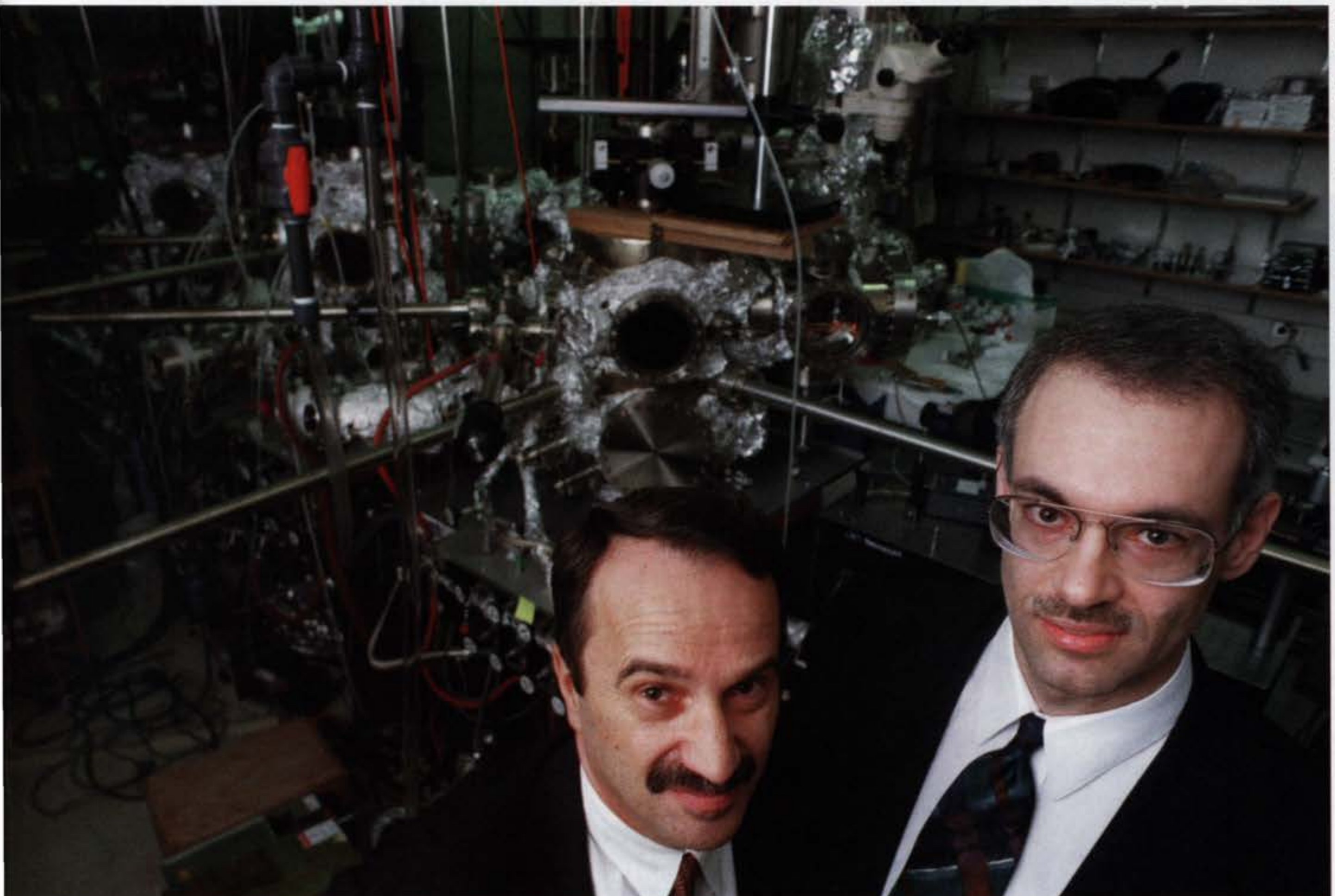
"When you design a transistor, you will be able to make it faster by design, and you will get reliability that you otherwise didn't have," Kizilyalli said. "Anything that's reliable is typically slow; that's the trade-off. With this thing, it's fast and reliable."

Lyding is hoping that news of the discovery will generate interest among private companies. He said switching from using hydrogen to deuterium in processing microchips would be easy and relatively inexpensive. He said AT&T and IBM have already expressed interest in the new treatment.

"The semiconductor industry is very conservative, so to introduce a new technology, you have to do more experiments. It may slowly creep into the process over time," Kizilyalli said.

"Once this is announced, people will be trying it in the lab immediately. Whether it appears in the manufacturing line is a matter of time. There's a good possibility." ●

Jodi Heckel is a staff writer with the Champaign-Urbana News-Gazette.



UIUC professors Karl Hess, left, and Joseph Lyding pose in front of a scanning electron tunneling microscope at UIUC's Beckman Institute for Advanced Science and Technolopy. Both have appointments as senior research scientists at NCSA.

Virtual Reality and Networks

Interview with Tom DeFanti

Why visualization experts need to know about networks.


Jeff Carpenter, NCSA

Tom DeFanti dons shutter glasses in preparation for viewing NCSA's virtual environments.

Until recently most computer graphics people didn't particularly care how their data got from one computer to another, but that was before distributed computing forced networking into a higher profile. Now optimizing the links between computers can be as critical to the performance of a visualization as is the software that converts the bits into images.

In a recent interview with Heide Foley of *Mondo 2000* magazine, Tom DeFanti, associate director of NCSA's Virtual Environments Graphics Division and director of UIC's Electronic Visualization Laboratory, talked about implications of these cojoining technologies. He discussed the lessons he learned from I-WAY at SC'95 [see *access*, Spring 1996, page 8; Fall 1995, page 14] as well as the networking hurdles virtual reality (VR) is trying to overcome.

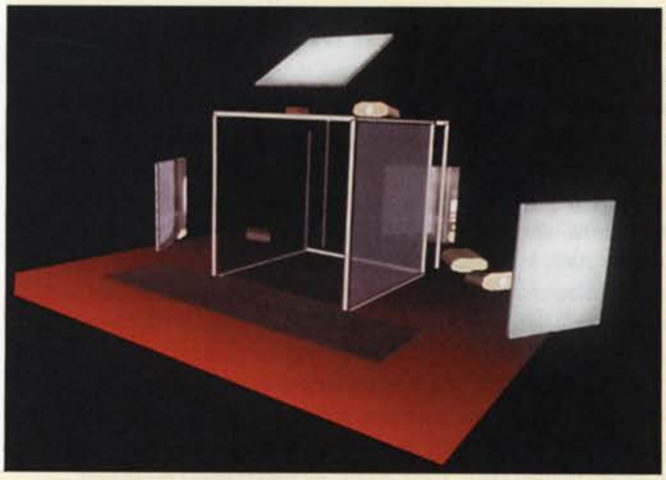
HF: What's the big deal about ATM?

TD: ATM—Asynchronous Transfer Mode—networking is roughly 10,000 times faster than your PC's modem. Another 4- to 64-times speedup is in the works. Getting email 10,000 times faster is not particularly important, but let's look at what is worth a $10,000 per month phone bill and why.

HF: Clearly this is all aimed at virtual worlds . . .

TD: And mass suspension of disbelief, which requires more power and infrastructure than anyone can afford. The genius of ATM is not so much that it works (people have been doing even faster networking for years now), but that it works using the same equipment that switches voice. This means that when the switch that handles the phone calls in Anytown, USA, is upgraded, it will automatically be able to handle both voice and high-speed data. It also means that the computing power you need to warp reality is not limited to what you have onsite. It can be anywhere. In fact, computing power may migrate into the switches themselves; after all, they're just computers. The dream [for high-performance computing] is to access computer power like you do electrical power; that is, you plug in, draw as much as you want, and pay for it by the unit. Nobody cares where the power is coming from.

The wonderful thing about fiber optics is that the fiber itself is not the limiting factor in transmitting data—we have barely touched its potential capacity. The bottleneck is the electronics—the routers and switches—that take information on and off the fiber. They are slow, but they are getting faster. Perhaps photonics—optical processing—will take over. Replacing electronics with photonics is easier and far, far cheaper than redoing the fiber. This is very good news and a reason for optimism.



Computer-generated image of the CAVE.

HF: So I-WAY at SC'95 was a stress test for hardware-software collaboration, right?

TD: That's for sure. The pieces were all there, it was just that no one had put them together. We wanted to connect thousands of fast processors over high-speed networks. I-WAY (*way* in the sense of *extreme* as in *way cool*) became a hardware-software networking experiment totally tuned to driving virtual reality with high-end computational science.

HF: How big can such a network get? What are the limiting factors of scalability of parallel processing over networks?

TD: I-WAY was designed to help ferret out the right questions and to be a cyberlaboratory for working out the answers. The basic problem with massively scalable parallel processing is in breaking down or decomposing the problem so that individual processors can do significant work in parallel with lots of other ones yet keep data updated in synch. Certain problems decompose elegantly; some very badly. Most are in between. They exhibit sensitivity to the number of processors, the amount of memory in each processor, and the efficiency with which the processors cross-communicate. The communication mechanisms are the focus of lots of study now, and the I-WAY is an ideal national facility for such experiments. The VR we do—the CAVE and so on—was developed specifically to stress test the networks and supercomputers and to provide a human-computer interface intense enough to display and navigate through the incredible number of parameters.

HF: The buzz is that supercomputing is going away.

TD: I was once asked what would replace supercomputing. I answered, "superduper computing." In the last 10 years, computational science has become a reality. Funding and machines have become generally available outside the major government high-energy physics labs. This is the revolution that will change our lives. The Web, by comparison, is simply a data structure.

HF: What? Certainly the Web is more than a data structure!

TD: Ultimately it will be. Adding intelligence to the Web is the direction in which many of us are going. Java applets, for instance, are downloadable code pieces that, among other things, do simulations (equations, basically). This advances the Web beyond being a huge storage disk, and it is why Java is so hot. Applets, though, are limited to the processing power on your desktop machine. Right now the Web stores information, like the sine and cosine tables you had in math class. But you really want to compute the sines and cosines directly from equations so that you don't have to interpolate between values. Some things should be computed directly, like spreadsheets. The goal of I-WAY is to let you click on an applet to run computations and simulations on dozens of major machines.

HF: Can't workstations do computations well enough already?

TD: The lines are blurring, which is why classical supercomputing is vanishing. Workstations now have the memory and speed (and 64-bit hardware-software) that Cray supercomputers had just a few years ago. Jo(e) Scientist can do truly significant simulations on the desktop. However, computing in real time is different. I cannot imagine having enough computing for that. We will get major advances through parallelism. Supercomputers will not disappear, but they will be constructed differently. For instance, frames in the movie *Toy Story* likely took 10,000 to 1 million times longer than real time to compute. Pixar used massive workstation parallelism to finish the job. If *Toy Story* had been done on one processor, it wouldn't have made it to theaters in your lifetime.

HF: Is massive parallelism a way to give the Web consciousness?

TD: We wish! We really do. Maybe it is the word consciousness that's difficult to deal with as opposed to smartness. If there is consciousness to be had, though, it would probably be a good idea to be able to document and recall it somehow.

One major gap we have is in recording virtual reality worlds and our paths through them. Remember that writing was invented to preserve culture and knowledge. TV and movies are used in the same way. VR needs to have the capability for recording, editing, and playing back experiences for it to be taken seriously as a cultural transformation mechanism. Another way of saying it is "if you can't reproduce it, it ain't science." Recording is a fundamental part of science.

HF: Why can't you record VR?

TD: An argument we have had for a long time with industry is about why visualization systems should be video compatible and why HDTV and workstation screens ought to be the same, or at least be interoperable. The TV manufacturing industry has its own serious legacy problems. Recording VR is not an issue of getting lots of high-resolution screens on and off tape because too much important geometrical information is lost through projection onto the frame. Since VR works at gigabits per second, you have to somehow compress the data to get it over networks or even off a local SCSI disk. We are working on compressing VR experiences by saving only the geometrical data and a user's path through it. Remember, a path is really a series of points. Just as a movie is a series of still images that you buzz through, a path is a series of perspective points that show you where you're pointing. If you preserve the paths as geometries, you can interact with them.

What you don't want to do in virtual reality is transmit bit maps—you want to send them as geometries. The bandwidth of the CAVE is something like 8 gigabits a second, which is absurd. So you wouldn't record them as bit maps anyway—at least not until you can recreate everything you could possibly want in real time—which, as you know, is the frontier.

HF: What did you discover from the SC'95 stress test?

TD: The need for quality human-computer interfaces to the ATM networking gear is extreme. I-WAY was designed to bring together networking and computer philosophies in very deep ways. Computer scientists know advanced methods of presenting information via graphical user interfaces, and they know how to efficiently manage large databases. Networking experts need these tools implemented. Virtual reality—which amazingly enough seems to be a mature technology in 1996—is likely to provide the best graphical computer interface. The amount of spatial data and its real-time demands far exceed the capacity of current Web-browser technology.

NCSA's Virtual Reality Environments

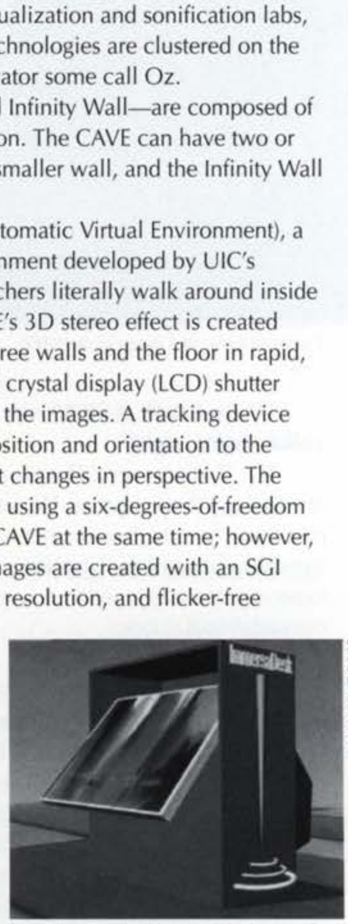
by Maxine Brown

Hundreds of academic and industrial researchers are drawn to NCSA each year to work with its commanding assemblage of virtual environments, visualization and sonification labs, and postproduction suite. These cutting-edge visualization technologies are clustered on the third floor of UIUC's **Beckman Institute**—the stop on the elevator some call Oz.

The virtual environments—the CAVE, ImmersaDesk, and Infinity Wall—are composed of "walls," each of which has the resolution of an SGI workstation. The CAVE can have two or three walls and a floor, the ImmersaDesk has one physically smaller wall, and the Infinity Wall has four walls on a plane.

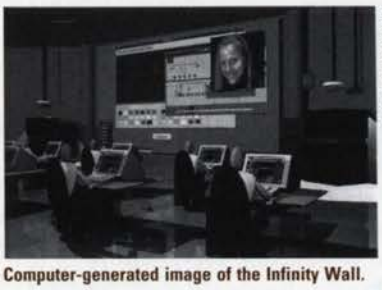
A big draw to the third floor is NCSA's **CAVE™** (Cave Automatic Virtual Environment), a 10 x 10 x 9-foot, high-resolution, 3D video and audio environment developed by UIC's Electronic Visualization Laboratory (EVL). In this room researchers literally walk around inside their simulation, effectively immersed in their data. The CAVE's 3D stereo effect is created when left-eye and right-eye images are rear-projected onto three walls and the floor in rapid, alternating succession. The images are viewed through liquid crystal display (LCD) shutter glasses whose lenses open and close in synchronization with the images. A tracking device attached to the goggles communicates a researcher's head position and orientation to the computer, which continually updates the simulation to reflect changes in perspective. The researcher navigates through the data or steers the simulation using a six-degrees-of-freedom wand. Several people can put on LCD glasses and be in the CAVE at the same time; however, their perspective is that of the person being tracked. CAVE images are created with an SGI Onyx system with RealityEngines and exhibit the same color, resolution, and flicker-free qualities as workstations.

A scaled-down version of the CAVE is the **ImmersaDesk™**, a drafting table format, VR projection-based display. When folded it fits through a standard door frame; when deployed it fills a 6- x 8-foot footprint. Images on the ImmersaDesk are viewed and navigated with the same LCD stereoscopic glasses, tracker, and wand used in the CAVE. Driving the ImmersaDesk is an SGI Onyx or Impact system. Resolution is 1,024 x 768 pixels with the RealityEngine2 graphics subsystem or 280 x 1,024 pixels with the new Infinite RealityEngine system.



Jason Leigh, EVL/UIC

Computer-generated image of the ImmersaDesk.


Jason Leigh, EVL/UIC

Computer-generated image of the Infinity Wall.

NCSA's newest virtual environment is the **Infinity Wall™**, a creation of EVL, NCSA, and Paul Woodward's Laboratory for Computational Science and Engineering at the University of Minnesota. Whereas the ImmersaDesk brings VR into the office, the Wall can fill a classroom or boardroom. LCD glasses and wands control the imagery, with tracking limited to one person.

The Infinity Wall consists of four screens tiled together in a 2 x 2 format. Each screen is powered by a projector at full workstation resolution. The resulting 12- x 9-foot image holds as much information as four workstation screens. It can run in three modes:

- large single nonstereo workstation mode
- stereo high-resolution mode driven by two or four SGI Infinite RealityEngines
- mono high-resolution mode driven by two SGI Infinite RealityEngines using software from the University of Minnesota to play back stored data at a rate of 90 minutes per terabyte

All three virtual environments work with the CAVE library and, in varying degrees, with commercial packages such as PERFORMER, INVENTOR, VRML, CAD output, and SoftImage. They also couple to remote data sources, supercomputers, and scientific instruments. This past year EVL and the NCSA Virtual Environments Graphics Division began experimenting with video input, remote teleconferencing, and distributed virtual prototyping. With help from the Networking Development Group at NCSA, they will be connecting the CAVE, ImmersaDesk, and Infinity Wall to ATM-based 155-Mbps networks. All three are connected locally via an ATM switch and to other CAVEs and ImmersaDesks over the vBNS and the

Maxine Brown is the associate director of NCSA's Marketing Communications Division

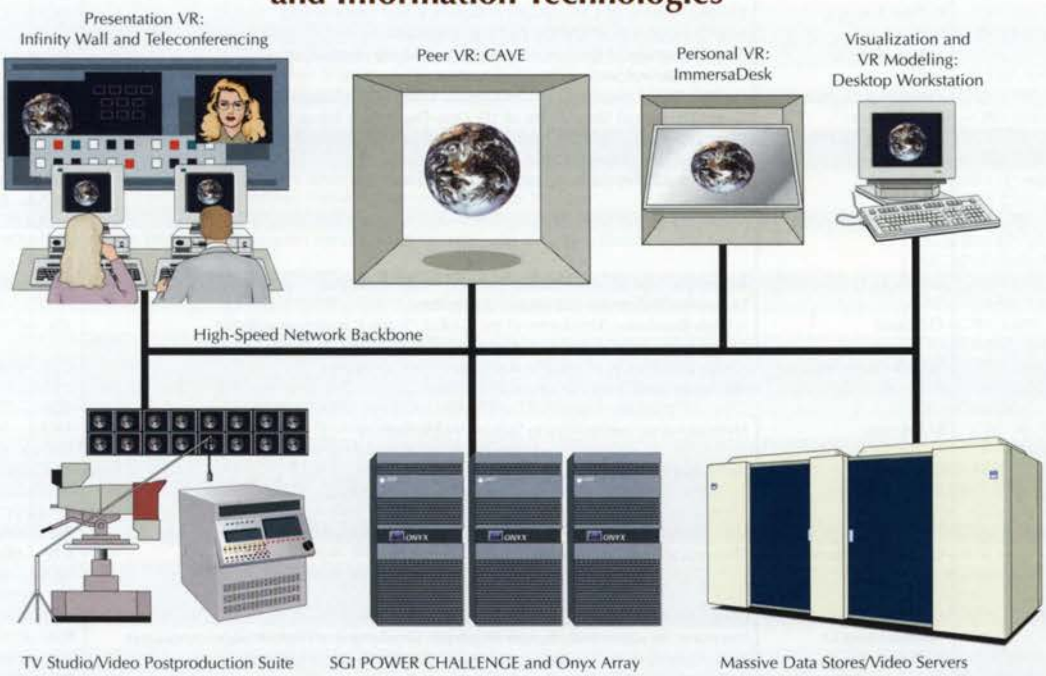
Ameritech Chicago-area Metropolitan Research and Education Network.

The Infinity Wall and ImmersaDesk are situated in the **Numerical Laboratory**. This laboratory and the **Renaissance Experimental Laboratory** are NCSA's training and teaching rooms. Both are outfitted with SGI workstations networked to the rest of NCSA's computers.

Adjoining the Numerical Laboratory is NCSA's **Sonification Laboratory**. Sound adds realism to VR and provides auditory cues about data. NCSA Sound Server software can synthesize and mix sounds in real time to provide localization, distance, and environmental cues and can algorithmically generate sounds from data (sonification) to enhance information.

In March the **Video Postproduction Suite**, operated by NCSA's Media Technology Resources Group, relocated near the virtual environments so that video recording and playback capabilities could be integrated with virtual reality. The group manages a state-of-the-art D1 digital video postproduction facility with component Betacam editing capability, Abekas digital video effects, digital audio, and an Abekas video frame store. The suite offers standard broadcast-quality video and audio production and editing as well as planned multiplatform desktop nonlinear editing capabilities linked to the online editing suite. Staff are working with NCSA's Scalable Metacomputing Group on video archiving and video serving research. ●

Integrating Interactive Mass Media Communications and Information Technologies



Virtual Environments Graphics Division http://www.ncsa.uiuc.edu/VEG/

Media Technology Resources http://fantasia.ncsa.uiuc.edu/media/

DLI Breaks the Semantic Barrier

UIUC DIGITAL LIBRARY INITIATIVE

Since its creation 30 years ago, information retrieval has been stuck at the level of word matching—unable to provide semantic retrieval across subject areas.

The first crack in the semantic barrier was achieved recently by researchers on the NSF/DARPA/NASA Digital Library Initiative (DLI) project using large-scale simulations on NCSA's HP/Convex Exemplar SPP 1200.

A large-scale simulation of vocabulary switching was run at NCSA by DLI researchers Hsinchun Chen and Bruce Schatz on the Illinois DLI project. (Chen is on the faculty of the University of Arizona's Department of Management Information Systems; Schatz is a research scientist at NCSA and is on the faculty of UIUC's Graduate School of Library and Information Science.)

Using a week of dedicated computer time (and 10 days of CPU time overall), concept spaces were generated for 10,000,000 journal abstracts across 1,000 subject areas in engineering and science. This is one of the largest computations carried out on NCSA's Exemplar system, and it is the first step towards generic protocols for semantic retrieval and information analysis for the next wave of the Net [see *access*, Spring 1995, page 6; Summer 1995, pages 17 and 43].

DLI http://www.grainger.uiuc.edu/dli/

MetaCenter Awards Resources

NCSA's Allocations Staff coordinated the 1996 MetaCenter Allocations Program and hosted the 1996 MetaCenter Allocations Committee (MAC) meeting on March 1, 1996, at the National Science Foundation (NSF) in Arlington, VA. The MAC is a joint panel drawn from the review boards of the NSF-funded high-performance computer centers (CTC, NCSA, PSC, and SDSC). Reviewers and allocations staff from all four centers and from NSF attended the meeting. Paul Young, Bob Borchers, Dick Kaplan, Mel Ciment, and Rich Hirsh from the CISE Directorate at NSF also attended.

Following the meeting, Borchers, director of the Division of Advanced Scientific Computing at NSF, commented in an email to Radha Nandkumar, NCSA Allocations team leader, "I was very impressed at the level of organization and commitment for the meeting. It bodes very well for the continuation of the program through the partnerships program. It is particularly gratifying to see the quality of science and engineering demonstrated in the competition and the dedication of the reviewers in seeing that the best [researchers] get the needed resources to do their work."

The MetaCenter Allocations Program facilitates a single mechanism by which researchers may request resources on any combination of vector and/ or scalable parallel platforms at any of the centers. The committee reviewed 72 proposals with requests for resources on 10 different platforms at the four centers. The following table summarizes the list of principal investigators who were recipients of the 1996 MAC awards effective from April 1, 1996, to March 31, 1997.

Principal Investigator	Institution	Project Title	Resources Awarded Center—System: Service Units
James Adams	UIUC	Atomistic Computer Simulation of Materials	NCSA—SGI PC: 10,700 PSC—C90: 20; T3D: 9,000
David Arnett	U Arizona	Type I and II Supernova Evolution and Nucleosynthesis Yields	CTC—IBM SP: 5,000 NCSA—SGI PC: 50,000 SDSC—T3D: 10,000
Susan Atlas	U New Mexico	Density Functional Calculations of Substitutional Impurity and Void Energetics in Al and Cu Grain Boundaries	NCSA—CM-5: 3,200
Robert Bach	Wayne State U	The Mechanism of Oxygen Atom Transfer and the Mechanism of Electrophilic Addition to Hydrocarbons	NCSA—SGI PC: 500 PSC—C90: 250
Alan Benesi	Pennsylvania State U	Parallel Power Averages in NMR Density Matrix Calculations	PSC—C90: 10; T3D: 30,000
Antony Beris	U Delaware	Direct Numerical Simulations of 3D Time-Dependent Viscoelastic Flows	PSC—C90: 20; T3D: 100,000
Jerzy Bernholc	North Carolina State U	Quantum Molecular Dynamics Simulations of Semiconductors, Fullerenes, and Biomolecules	PSC—C90: 1,921; T3D: 166,222
Edmund Bertschinger	MIT	The Formation of Galaxies and Large-Scale Structure	CTC—IBM SP: 250,000 NCSA—Exemplar: 12,500; SGI PC: 13,800; CM-5: 7,700 PSC—C90: 800; T3D: 200,000 SDSC—C90: 2,000
David Beveridge	Wesleyan U	Molecular Simulation Studies of Nucleic Acids: Structure, Dynamics, Solvation, and Ligand Interactions	PSC—C90: 3,000; T3D: 10,000
Rainer Bleck	U Miami	A High Resolution Simulation of the Global Ocean Circulation with the Miami Isopycnic Coordinate Ocean Model (MICOM)	PSC—C90: 50; T3D: 100,000
Charles Brooks III	Scripps Research Institute	Theoretical Studies of Peptide and Protein Dynamics and Thermodynamics via Computer Simulation	CTC—IBM SP: 2,000 PSC—C90: 2,500; T3D: 63,500 SDSC—T3D: 63,500
Adam Burrows	U Arizona	Hydrodynamic Instabilities in Supernova Explosions	NCSA—SGI PC: 4,000 PSC—C90: 1,000; T3D: 32,000
David Ceperley	UIUC	Simulations of Quantum Systems	CTC—IBM SP: 18,000 NCSA—Exemplar: 44,000; SGI PC: 14,000 PSC—C90: 1,110
Marvin Cohen	U California–Berkeley	Theoretical Solid State Physics	CTC—IBM SP: 10,000 NCSA—SGI PC: 8,956 PSC—C90: 2,490
Kelvin Droegemeier	U Oklahoma	Center for Analysis and Prediction of Storms	PSC—C90: 2,000; T3D: 100,000
Arthur Freeman	Northwestern U	Electronic Structure and Phonon Properties Simulations of High Tc Superconductors	PSC—C90: 1,300; T3D: 60,000
Richard Friesner	Columbia U	New Algorithms for Electronic and Molecular Modeling Calculations and Applications to Biological Problems	CTC—IBM SP: 42,000 PSC—C90: 1,550
John Georgiadis	UIUC	Lattice Boltzmann Simulation of Tortuous Flow and Stirring in Complex Domains	NCSA—CM-5: 6,000
Ahmed Ghoniem	MIT	Vortex Simulation of Turbulent Reacting Flows	NCSA—SGI PC: 9,000; CM-5:1,200 PSC—C90: 1,710; T3D: 60,000
William Goddard III	California Institute of Technology	Atomistic Simulations of Chemical Materials, and Biological Systems: Developing New Methods and Software and Applications to Significant Problems	CTC—IBM SP: 1,900 NCSA—SGI PC: 4,800 PSC—C90: 1,500 SDSC—C90: 500; T3D: 9,500
Keith Gubbins	Cornell U	Molecular Simulation of Fluid Behavior in Narrow Pores and Pore Networks	CTC—IBM SP: 30,000 PSC—C90: 1,200; T3D: 10,000
Herbert Hamber	U California–Irvine	Studies of Quantitized Gravity	CTC—IBM SP: 20,000
Timothy Harrigan	U Texas Health Science Center–Houston	Changes in Bone Around Total Hip Implants: Identifying Which Radiographic Changes Can Be Explained by Mechanical Effects, and Which Cannot	PSC—C90: 940 CTC—IBM SP: 3,000
Peter Hauschildt	Arizona State U	Non-Standard Stellar Atmospheres	SDSC—C90: 700
James Haw	Texas A & M	NMR Experimental and Computational Chemistry Investigations of Solid Acid Crystals	NCSA—SGI PC: 6,000
John Hawley	U Virginia	Computational Magnetohydrodynamics for Astrophysical Systems	NCSA—CM-5: 3,800 PSC—C90: 1,600
Kendall Houk	UCLA	Organic Reactivity, Biological Catalysts, Asymmetric Organic Reactions, and Carceplexes	NCSA—SGI PC: 8,000 SDSC—C90: 1,000
Chi Hu	California State U–Long Beach	Multichannel Scattering Cross Sections via the Faddeev Equations	SDSC—C90: 800
Eric Jakobsson	UIUC	Computational Studies of Biological Membranes	NCSA—Exemplar: 7,000; SGI PC: 7,000
John Joannopoulos	MIT	Ab-Initio Simulations of Materials Properties	NCSA—CM-5: 5,375 PSC—C90: 1,100; T3D: 60,000 SDSC—C90: 1,900
Kenneth Jordan	U Pittsburgh	Theoretical Studies of Water Clusters and of Chemical Processes on the Si(100) 2x1 Surface	NCSA—SGI PC: 2,000
George Karniadakis	Brown U	Self-Steering Parallel Simulations of Complex Geometry Flows	CTC—IBM SP: 110,000 NCSA—Exemplar: 1,000; SGI PC: 2,300 PSC—C90: 5; T3D: 85,000

Principal Investigator	Institution	Project Title	Resources Awarded Center—System: Service Units
John Kim	UCLA	A Numerical Study of Turbulent Boundary Layers	CTC—IBM SP: 6,000 SDSC—C90: 1,775
Michael Klein	U Pennsylvania	Quantum and Classical Simulations of Molecular Aggregates	CTC—IBM SP: 25,000 PSC—C90: 3,000; T3D: 32,000
Peter Kollman	U California–San Francisco	Simulations on Complex Molecular Systems	CTC—IBM SP: 10,000 NCSA—Exemplar: 15,000; SGI PC: 3,000 PSC—C90: 750; T3D: 100,000 SDSC—C90: 750
George Lake	U Washington	Formation of Galaxies and Clusters in a Cosmological Context	CTC—IBM SP: 150,000 PSC—C90: 50; T3D: 150,000
David Landau	U Georgia	Computer Simulations of Critical Behavior	CTC—IBM SP: 18,400 PSC—C90: 452; T3D: 10,000
Uzi Landman	Georgia Institute of Technology	Fundamental Studies of Interfacial Complex Molecular Systems and Nanotribology	PSC—C90: 3,000; T3D: 10,000
Ronald Levy	Rutgers U	Supercomputer Simulations of Liquids and Proteins	CTC—IBM SP: 5,000 PSC—C90: 2,160; T3D: 85,800
Shoudan Liang	Pennsylvania State U	Divide-and-Conquer Approach to Electron Correlations	NCSA—CM-5: 4,000
Gilda Loew	Molecular Research Institute	Theoretical Studies of Two Families of Ubiquitous Metabolizing Heme Proteins: Peroxidases and Cytochrome P450s	PSC—C90: 500; T3D: 59,000
John Marko	Rockefeller U	Equilibrium Phase Transitions in a Porous Medium	PSC—C90: 20 SDSC—C90: 20; T3D: 50,000
William Matthaeus	U Delaware	Turbulence, Shocks, Energetic Particles, Transport, and Large Scale Structure in Cosmic and Heliospheric Plasmas	SDSC—C90: 1,000
Richard Matzner	U Texas–Austin	Black Hole Binaries: Coalescence and Gravitational Radiation	CTC—IBM SP: 5,000 PSC—C90: 1,500; T3D: 10,000 SDSC—C90: 500; T3D: 30,000
James McCammon	U California–San Diego	Theory of Biomolecular Structure and Dynamics	NCSA—SGI PC: 6,500 SDSC—C90: 2,750; Paragon: 200,000
James McWilliams	UCLA	Coherent Structures and Statistical Dynamics of Rotating, Stratified Turbulence at Large Reynolds Number	CTC—IBM SP: 10,000 PSC—C90: 2,500; T3D: 100,000
James McWilliams	UCLA	Coherent Structures and Turbulent Dynamics of Anisotropic Magnetohydrodynamics	NCSA—SGI PC: 13,000
Kenneth Merz Jr.	Pennsylvania State U	Computer Simulation of Biomolecular Structure, Function, and Dynamics	CTC—IBM SP: 50,000 PSC—C90: 200; T3D: 100,000
Gregory Olson	Northwestern U	Stress-Corrosion Resistant Ultrahigh-Strength Steels: Modeling and Simulation	PSC—C90: 1,600; T3D: 48,000
Charles Peskin	New York U	Cardiac Fluid Dynamics and the Immersed Boundary Method	CTC—IBM SP: 3,000 PSC—C90: 5,000; T3D: 3,000
Montgomery Pettitt	U Houston	Salt Effects in Solutions of Peptides and Nucleic Acids	CTC—IBM SP: 40,000 PSC—C90: 1,300; T3D: 8,000 SDSC—C90: 1,500
Fedor Pikus	U California–Santa Barbara	Dielectric-Superconductor and Dielectric-Metal Transitions in Two-Dimensional Electron Gas	PSC—C90: 50 SDSC—C90: 50; T3D: 8,000
Joel Primack	U California–Santa Cruz	What Is the Dark Matter in the Universe?	CTC—IBM SP: 30,000 NCSA—Exemplar: 15,000; SGI PC: 2,000; CM-5: 1,500
James Riley	U Washington	Direct Numerical Simulation of Nonpremixed Turbulent Combustion	NCSA—CM-5: 5,000
Paul Roberts	UCLA	Modeling the Generation and Dynamics of the Earth's Magnetic Field	PSC—C90: 2,500; T3D: 50,000
Ashkok Sangani	Syracuse U	Hydrodynamic Interactions in Suspensions	CTC—IBM SP: 25,000
Klaus Schulten	UIUC	Simulations of Supramolecular Biological Systems	NCSA—Exemplar: 50,000 PSC—C90: 200; T3D: 50,000 SDSC—C90: 1,900
Edward Seidel	UIUC	Computational Relativity and Relativistic Astrophysics	CTC—IBM SP: 150,000 NCSA—Exemplar: 10,000; SGI PC: 10,000; CM-5: 15,000 PSC—C90: 700; T3D: 100,000
Jay Siegel	U California–San Diego	Fundamental Intermolecular Interactions Involving Aromatic Residues	SDSC—C90: 200; T3D: 10,000; Paragon: 44,544
Alan Sokal	New York U	New Numerical Methods for Quantum Field Theory and Critical Phenomena	CTC—IBM SP: 50,000 PSC—C90: 1,440; DEC Alpha: 15,000
Shankar Subramaniam	UIUC	Computer Simulations of Biomolecular Structure and Association	NCSA—Exemplar: 15,000; SGI PC: 7,000
Robert Sugar	U California–Santa Barbara	Lattice Gauge Theory on MIMD Parallel Computers	CTC—IBM SP: 150,000 NCSA—CM-5: 11,875 PSC—C90: 275; T3D: 150,000 SDSC—C90: 100; T3D: 150,000; Paragon: 475,000
Peter Taylor	SDSC	Structures, Energetics, and Properties of Molecules	CTC—IBM SP: 20,000 SDSC—C90: 4,143; T3D: 24,000; Paragon: 16,000
Juri Toomre	U Colorado–Boulder	Coupling of Turbulent Compressible Convection with Rotation	CTC—IBM SP: 200,000 NCSA—SGI PC: 60,000 PSC—C90: 2,000; T3D: 100,000
Gregory Voth	U Pennsylvania	Electron Transfer across the Electrode/Electrolyte Interface: Proton Translocation in Water and Biological Systems	CTC—IBM SP: 18,000 PSC—C90: 2,200
Norman Wagner	U Delaware	Massively Parallel Simulations of Colloidal Suspension Rheology	NCSA—CM-5: 4,875
Birgitta Whaley	U California–Berkeley	Quantum Monte Carlo Studies of Doped Quantum Clusters, Fluids, and Solids	NCSA—Exemplar: 3,000 PSC—DEC Alpha: 3,000 SDSC—C90: 500
Ralph Wheeler	U Oklahoma	Properties of Radical Electron Transfer Cofactors and Charge Transfer Complexes	CTC—IBM SP: 4,000 NCSA—SGI PC: 4,000
Robert Wilhelmson	UIUC	The Numerical Simulation of Convective Clouds and Related Phenomena	NCSA—Exemplar: 5,500; SGI PC: 1,000; CM-5: 2,963 PSC—C90: 515
Bernard Zeigler	U Arizona–Tucson	Massively Parallel Simulation of Large Scale, High Resolution Ecosystem Models	CTC—IBM SP: 8,000 NCSA—CM-5: 1,440

VRML: Animated Worlds for the Web

by Polly Baker



PICTURE THIS: USING YOUR WEB BROWSER TO FLY THROUGH A SPACETIME DIAGRAM OF COLLIDING BLACK HOLES, TO SPIN A MOLECULE AND VIEW IT FROM ALL SIDES, OR TO NAVIGATE THE WEB BY WALKING FROM ROOM TO ROOM.

Industry-wide adoption of VRML—the Virtual Reality Modeling Language—makes it possible to share 3D graphics over the World Wide Web. VRML is a specification language that lets the author of a VRML world define objects and specify parameters for how they should be rendered. VRML-capable browsers interpret the VRML document and draw the scene. Browsers are interactive, allowing the user to move around and visit different parts of the world or view from different vantage points. Browsers are available for PCs, Macintoshes, and all major UNIX platforms, making it possible to use the Web to provide interactive 3D graphics in a platform-independent manner.

Objects, cameras, action!

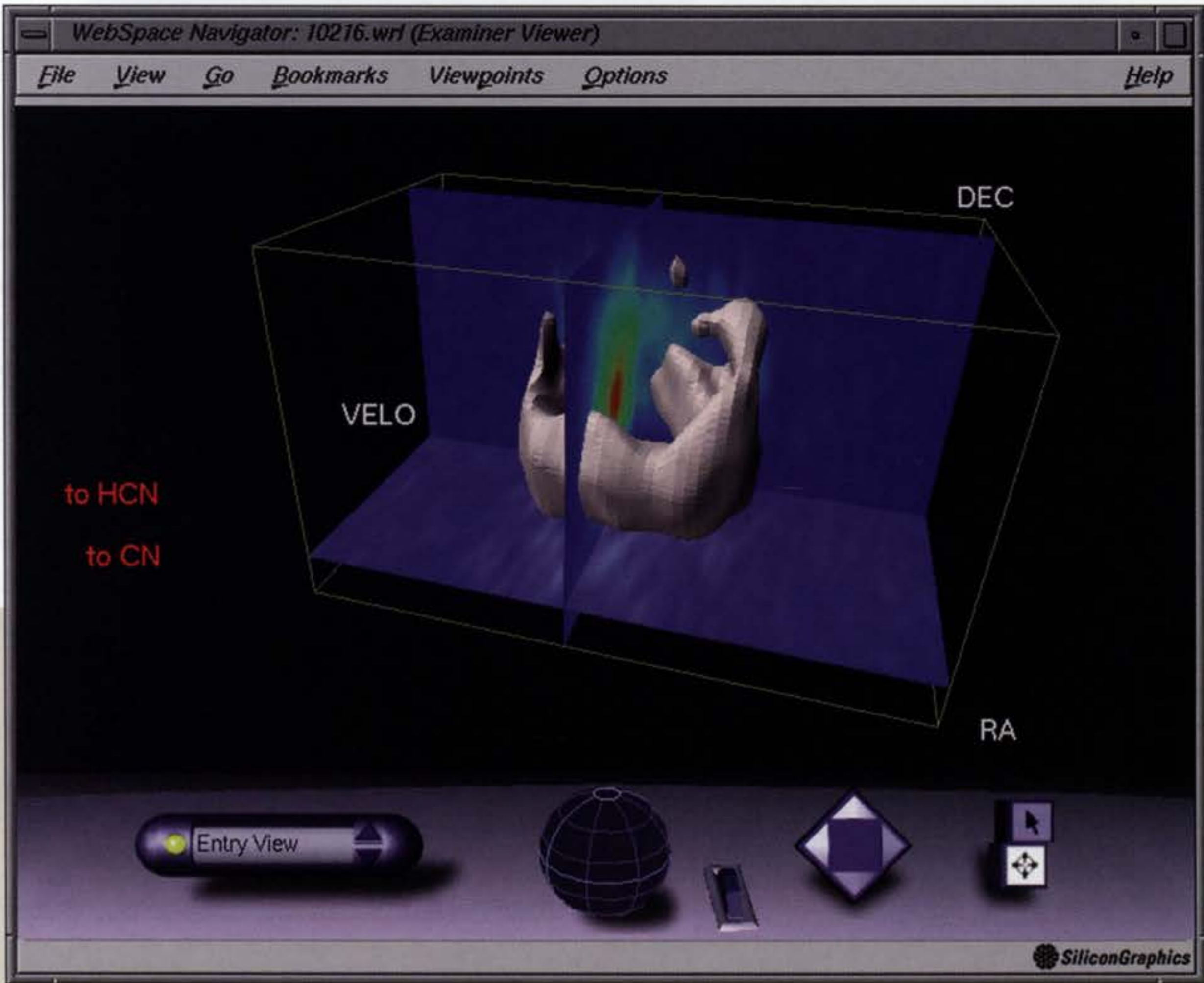
VRML has evolved through two releases. VRML 1.0, adopted in the spring of 1995, is a language for describing static 3D worlds. A world can be populated with simple shapes, such as spheres, cubes, cones, and cylinders, or objects composed of arbitrary lines and polygons. Object attributes, such as color or opacity, can be specified. Primitive objects and their attribute specifications are collected together to form a group, and groups can contain other groups. Standard graphics transformations scale, rotate, or change the position of objects and groups. Finally, the VRML author can add various lights and cameras to a VRML world.



VRML 2.0 extends the functionality of the early standard to incorporate animated behaviors into a VRML world. A variety of vendor groups advanced proposals for achieving animated VRML. Moving Worlds, a specification proposed by a group of about a dozen organizations and spearheaded by Silicon Graphics Inc. (SGI), has emerged as dominant and is now endorsed by more than 50 organizations. VRML 2.0 browsers will become available this summer, dramatically extending the possibilities for sharing and exploring 3D worlds.

In Moving Worlds, geometry objects include *input fields.* The VRML author connects these input ports to entities that supply new values. Imagine being able to download a virtual flow field—when you click *Go,* tracer particles move along their appropriate paths to reveal the characteristics of the flow. Moving Worlds makes this possible by attaching the particles' positions to Interpolator objects—animators that modify object positions by interpolating through a set of control points.

Moving Worlds also supports event-driven animation using Sensor objects. For example, the hands of a clock could be driven by a TimeSensor. At regular intervals, the TimeSensor generates events that are then forwarded to the clock's geometry.



Courtesy Polly Baker

Figure 1. The WebSpace Navigator window shows a red giant star nearing the end of its life (from the Digital Image Library). The shell contains cyanide, and the center of the envelope contains hydrogen cyanide. A beta version of NCSA DataView generated the VRML file depicted.

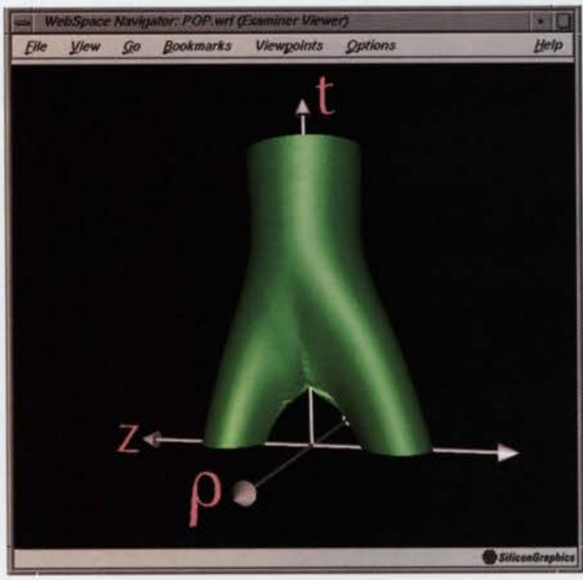


Figure 2. A spacetime diagram of the geometric embedding of the event horizon of two colliding black holes.



Figure 3. The Teukolsky wave evolution. Red surfaces show negative amplitudes; blue surfaces show positive amplitudes.

Images courtsey Polly Baker

More complicated behaviors can be accomplished by using Scripts. Scripts are C programs or Java applets using the Java package *vrml*. Writing scripts in Java provides complete platform-independence—the applet can simply be downloaded along with the VRML file.

In addition to behaviors, Moving Worlds extends VRML to include sound. A VRML author can specify the URL of an audio clip to be played. Sounds have locations, and the VRML author can control how the sound should change as a user moves closer or farther away.

In its basic capabilities, VRML mimics the functionality found in contemporary graphics systems. In fact, the VRML language is based on the file format used in OpenInventor, an object-oriented software system for graphics programming developed by SGI and licensed by many major vendors. SGI fully endorses the development of VRML as an open standard within the Web community.

VRML is distinguished from non-Web graphics systems by the addition of the *WWWAnchor* object. Any piece of VRML geometry can serve as a hyperlink, by bundling the geometry and a URL into a WWWAnchor. In the browser, when a user's mouse moves over the geometry, it highlights in some fashion, perhaps by changing color. Clicking on the geometry activates the link and loads the associated Web document. The link might connect to a text file or audio document explaining some aspect of the VRML world or to a new VRML world. For example, in a world composed of a central foyer and multiple rooms, clicking on a door could usher the user into the new room by loading the appropriate VRML file.

VRML browsers

VRML browsers are available for many major platforms. Initially, these browsers took the form of external helper applications. More recently, VRML plug-ins have become available, supporting VRML display embedded within the user's regular HTML browser.

One of the most widely used external browsers for VRML 1.0 is WebSpace, pictured in Figure 1. CosmoPlayer is a VRML 2.0 browser available from SGI for UNIX and Windows platforms. WebSpace is a shared-development project between SGI and Template Graphics Software Inc. (TGS), a leading supplier of graphics software for UNIX machines and for PCs. Browsers for SGI, Sun, and IBM AIX, as well as Windows 95 and Windows NT are currently downloadable at the TGS Web site. Other VRML browsers, both commercial and public domain, are available. An up-to-date source of information about browsers (and all things VRML) is the comprehensive VRML repository maintained by the San Diego Supercomputer Center.

VRML at NCSA

NCSA uses VRML to share visualizations of scientific data with colleagues, students, and the public. For example, the Radio Astronomy team couples VRML files with the Astronomy Digital Image Library. The image library is a Web-accessible repository of hundreds of datasets deposited by astronomy researchers for community use. Scientists can browse the image library seeking datasets related to their research problems and can download those that may be useful. Raster images and .mpeg movies were initially provided to support browsing the data collection. The emergence of VRML has provided a new way to browse the database, taking advantage of the greater expressiveness of 3D representations.

Figure 1 [see page 21] shows a VRML file from the Digital Image Library that depicts two related datasets, the work of A. Dayal and J. H. Bieging from the University of Arizona. The image shows the star IRC+10216—a red giant nearing the end of



Vijay Jaswal and Derek Storr, NCSA

Figure 4. A Virtual Sears Store. Store personnel can evaluate the display of Sears Craftsman tools shown here.

its life as a star. As part of this life stage, it is expelling its outer layers in a massive wind. As the material in the wind cools, molecules such as CN (cyanide), HCN (hydrogen cyanide), and HCO+ (which doesn't exist on Earth) can form. Astronomers observe the spectral line emission from these molecules to study the chemical processes at work, as well as how the mass loss affects the evolution of the star. This particular image shows that CN is found in the shell surrounding the central star, while the HCN is found concentrated toward the center of the envelope.

The VRML file shown in Figure 1 was generated with a beta version of NCSA DataView. DataView is a tool for desktop visualization and VRML-generation. DataView reads HDF files [see *access*, Spring 1996, pages 14–16] and represents the data as slices, contour plots, surfaces, and isosurfaces. Built using SGI's OpenInventor, DataView can capture the current state of a work session as a VRML file, which can then be downloaded to any platform's VRML browser. A companion application, DataCAVE, has the same visualization capabilities as DataView but operates in NCSA's virtual environments and provides physically immersive user control. Like DataView, DataCAVE can record the current state of the CAVE visualization as a VRML file. This snapshot of the CAVE session is useful for later display on the desktop or for sharing with colleagues over the Web. Developed within the Applications and Virtual Environments Graphics divisions, DataView and DataCAVE are scheduled for release this fall.

A variety of other strategies for producing VRML worlds of scientific content are being pursued. One easy approach is using the freely available conversion programs that translate the Wavefront geometry format or AutoDesk files to VRML. NCSA's numerical relativity and cosmology teams produce their VRML scenes using custom-built shell scripts to translate to VRML the output of popular visualization programs, such as IRIS Explorer and IDL (Interactive Data Language). For example, Figure 2 shows the spacetime diagram of the embedding of the event horizon of two colliding black holes. Figure 3 presents the Teukolsky wave evolution, with negative amplitudes shown as red surfaces and positive amplitudes shown as blue.

VRML has numerous applications in business and commerce. Sears and NCSA are collaborating to build a Virtual Sears Store using VRML (see Figure 4). The VRML file can be viewed in the CAVE or in the desktop WebSpace browser. In either case, store personnel can wander the store's aisles evaluating product displays and traffic patterns and experimenting with alternate arrangements.

In addition to science and business, VRML has obvious applications in education. Because it is platform-independent and sharable over the Web, VRML lowers the traditional barriers to 3D animated graphics that have existed for decades. NCSA researchers and educators welcome and intend to pursue aggressively this new opportunity to share animated 3D worlds with the Web community. ●

More information about VRML is available at the following Web sites:
http://www.ncsa.uiuc.edu/Indices/Spotlight/VRML
http://www.sdsc.edu/vrml
http://vrml.sgi.com
http://www.sd.tgs.com/~template/WebSpace
http://imagelib.ncsa.uiuc.edu/imagelib.html
http://jean-luc.ncsa.uiuc.edu/Viz/VRML

Polly Baker is a visualization research scientist working in NCSA's Applications and Virtual Environments Graphics divisions.

NCSA Web Update



HPC User Information Available

Ever wonder what type of research is being done at the NSF-sponsored high-performance computing centers? How about geographic distribution of the researchers or how much time was used in July?

Now you can find answers to these and related questions by checking the National Supercomputer Centers Usage Database, an ongoing Web-based project gathering usage statistics at the four NSF centers. Annual and monthly data are available. The database gives information on users, grants, accounts, and usage as well as project abstracts.

This Web site is by Quantum Research Corporation, under contract to the National Science Foundation. See URL bottom left. ●

HPC motd on Web

Users at NCSA now have another way to check /usr/news or the motd (message of the day) for the center's POWER CHALLENGEarray, Exemplar, and CM-5 systems. (See URL bottom left.)

Thanks to the efforts of consultants Ben Johnson and Paul Walker, /usr/news and motd messages are now available on the Web. The Web page is automatically updated every three hours, and entries are sorted by date and name. Set your bookmark today! ●

Federal Consortium—Moving Towards Collaboration Technology

Proving that they take challenges seriously, researchers at NCSA used the June 1996 annual meeting of the NSF/NCSA World Wide Web (N2W3) Federal Consortium to showcase several new software prototypes and projects that will help lead the Web's evolution from a medium for information dissemination into a forum for digital interaction.

Last year, Vice President Al Gore challenged NCSA and the other members of the consortium to move the Web beyond browsing and into collaboration. This year, he faxed them a letter congratulating them on a job well done while, of course, urging them to do more by broadening their horizons to include other sectors (international, state, and local government, academia, industry, and public and private institutions). During the past year, the 15 federal agencies that constitute the consortium responded to the vice president's challenge by compiling federal home page guidelines and by devising plans for electronically organizing their work places, for data mining, and for providing public access to information. NCSA, to whom the consortium looks for the technology, responded with software.

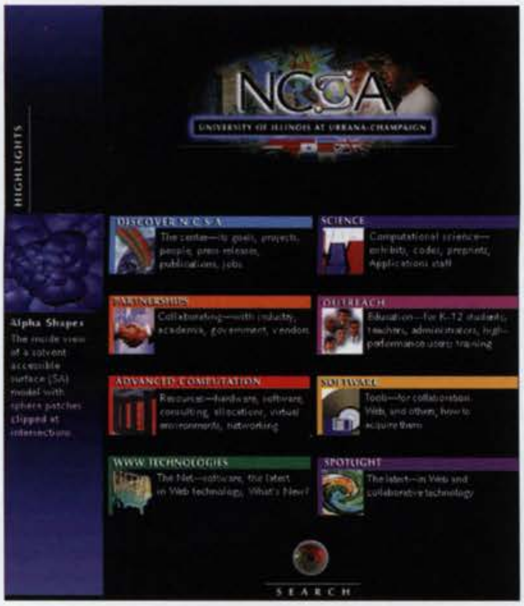
At the meeting, which was held June 18–20 at the Beckman Institute on the campus of the University of Illinois and attended by more than 50 people, NCSA rolled out several Web-based frameworks and networking projects specifically geared towards improving electronic collaboration. The networking projects included I-WAY—the multi-institutional, distributed computing project—and the Global Interoperability for Broadband Networks (GIBN) project, a testbed for linking the G7 nations [see *access*, spring 1996, pages 8 and 10].

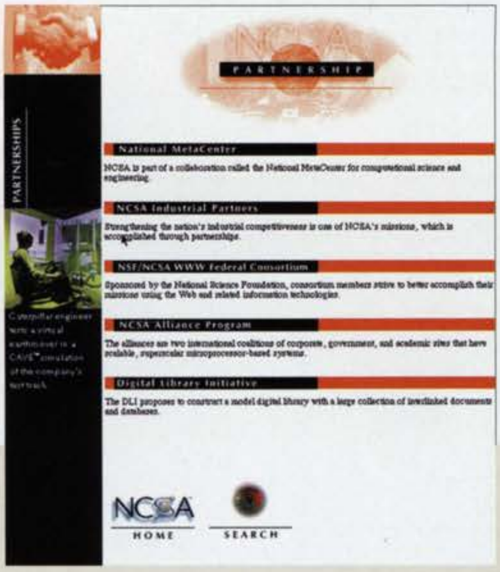
The highlight of the software presentations was a prototype of Habanero, NCSA's latest "killer app." Habanero is a Java-based, pluggable framework that supports synchronous as well as asynchronous collaboration. NCSA staff also demonstrated projects in the works to make Habanero more robust and secure. One project that is nearing beta stage is a tool that saves digital workplaces assembled with Habanero so that they can be retrieved later. It is ideal for convening weekly collaborative sessions. Other new software had participants thinking in terms of Web-based computing and more extensive use of video on the Web. (See NWebScope on page 33 and upcoming issues for stories on Habanero™, Vosaic™, and Biology Workbench™.) New Web pages for the consortium were unveiled just prior to the start of the meeting (see URL left).

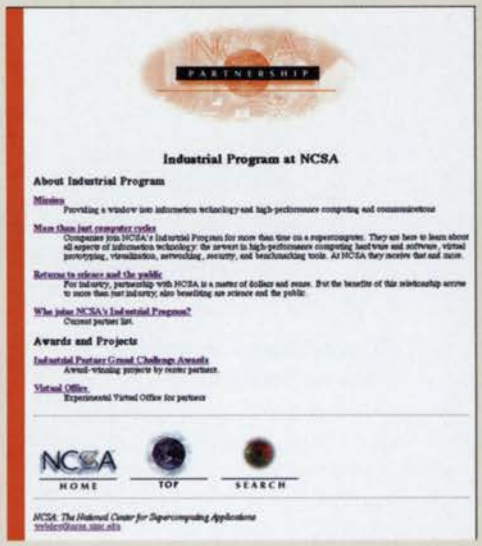
Among the most energetic sessions were the afternoon discussions in which participants presented wish lists for collaborative technology and sketched out their plans for incorporating these tools into their agencies. Others spoke optimistically of extending the boundaries of collaboration to foreign nations.

The N2W3 Federal Consortium [see *access*, Fall 1995, p. 28–30] promotes use of the Web among federal agencies. It also fosters collaborative research and development and information exchange among the agencies and NCSA. The consortium is sponsoring a Federal Webmasters Workshop on August 7–9 in Bethesda, MD. Janet Thot-Thompson, who manages a Technology Center at the Nuclear Regulatory Commission, is the current chair of the consortium.

HPC Users http://www.qrc.com/cise/asc/usagedb/start.htm
motd http://www.ncsa.uiuc.edu/General/Consulting/news/
N2W3 Federal Consortium http://skydive.ncsa.uiuc.edu/







New Home Pages for NCSA

In late April NCSA unveiled a new Web home page for the center as well as reorganized and redesigned secondary and tertiary Web pages. A centerwide committee began work on the reorganization in November 1995 with an analysis of NCSA's information, other Web sites, and new Web tools.

The NCSA Home Page Committee consisted of artists, writers, and technical staff: Maxine Brown, Carlton Bruett, Colleen Bushell, Ginny Hudak-David, Doug Fein, Jennie File, Ben Johnson, Melissa Johnson, Tom Magliery, Bob McGrath, Bridget Neu, Paulette Sancken (chair), Kim Stephenson, and Paul Walker. Bruett created the new graphics, and Walker, Ben Johnson, and Fein implemented the Java scripts used on the pages.

To maintain the new pages and coordinate updating and maintenance of the entire server, Maxine Brown, associate director of Marketing Communications, appointed Cordelia Geiken as NCSA's Webmaster. Geiken is responsible for ensuring that NCSA groups convert to the new templates in the coming months. She is also staying abreast of all Web technology issues and developments to keep NCSA state-of-the-art.

Other changes are taking place on NCSA's Web server. Excite! Inc. has joined with NCSA to help index the server contents. The Mountain View, CA, organization has provided its search engine to the center along with technical support and upgrades free of charge for a year. Use the *Search* link on the main NCSA pages to see how the Excite! search engine works.

Comments can be sent to webdev@ncsa.uiuc.edu. ●







Illinois manufacturing information online

This spring NCSA's Education and Outreach Division joined with the State of Illinois to showcase Illinois' economic development and technological resources using the World Wide Web.

The Illinois Coalition, a nonprofit group that spearheads efforts to strengthen the state's economy using science and technology, organized Project COMPETE, an integrated, statewide effort to help small- and medium-sized firms adapt or adopt modern business and industrial practices. The project is funded by the federal National Institute for Standards and Technology through the Illinois Department of Commerce and Community Affairs and the Management Association of Illinois.

The Web site (see URL left) was unveiled in March by Governor Jim Edgar. "Illinois is becoming a national leader in developing unique ways to encourage economic development," Edgar said. "The new Illinois Web site will help companies locate and utilize sources of technical and business modernization assistance that can help them become more competitive. It will help market the products of Illinois suppliers to manufacturers in the state and throughout the world and will promote economic development through a unique partnership between the public and private sectors."

The COMPETE Web site is the first in the nation to be electronically linked to a major online publisher of manufacturing information. Illinois and Thomas Regional Directory Company Inc. have joined together to allow users to seamlessly find information on manufacturing companies and products as well as the infrastructure in Illinois that supports them. ●



E&O's Frank Baker, multimedia developer, assists Illinois Governor Jim Edgar in navigating the COMPETE Web site.

COMPETE http://www.ncsa.uiuc.edu/ilcoalition/

NCSA Multicast

Multicast:(n) a message passing interface (MPI) operation whereby a single processor sends information to several other processors simultaneously

NCSA Multicast is a Web-based service provided by staff from Consulting Services, Publications, and other groups that give assistance to the center's high-performance users. The Multicast Web page is a one-stop resource for hyperlinks to user tips, performance data, white papers, technical specifications, and a host of other information that will aid HPCC users, whether at NCSA or another HPCC site.

Categorized by vendor and maintained using @ATS software (story planned for Fall 1996 issue of *access*), Multicast's URLs are added to regularly when another resource is located on the Web. Hardware and software vendors, users, and other computing centers are the sources of many of the links; technical information from NCSA staff will be added too. The goal is to make this Web page one that you check frequently.

Comments about this new service or the contents of the online Multicast page can be sent to Ginny Hudak-David (virginia@ncsa.uiuc.edu).

Multicast http://www.ncsa.uiuc.edu/General/Consulting/HPCC/MCast/

Kodak Wins NCSA's Industrial Grand Challenge Award

NCSA presented Eastman Kodak Co. with the 1996 Industrial Grand Challenge Award in early May at the Eighth Annual Executive Meeting. The award recognizes Kodak for unifying its photo compact disc format with the World Wide Web.

A major thrust of NCSA's mission is to help improve the competitiveness of U.S. industry. The Industrial Grand Challenge Award, presented annually, was established by NCSA in 1992 to recognize the corporation that accomplished a major competitive breakthrough application as a result of its NCSA partnership during the previous year. The 1996 award specifically recognizes the efforts of Terry Lund and his Digital Science team in Rochester, NY.



Wilmer Zehr

Left to right: Clark Kurtz, director of Research and Technical Support Services at Kodak; Larry Smarr, director of NCSA; and Terry Lund, leader of the Digital Science team at Kodak.

Kodak, jointly working with NCSA's Software Development Division, developed technology designed to allow people to zoom in and examine small details—particularly images transmitted over the Internet. NCSA staff collaborating with Kodak were Stan Guillory, Larry Jackson, Scott Powers, Carl Samos, Briand Sanderson, Rick Vestal, and Judd Weeks.

While people today can view low-resolution images over the World Wide Web, zooming in, enlarging, or cropping these images can be difficult if not impractical. Kodak's Digital Science solution, being made available free over the Internet, offers users a new level of interactivity with many pictures accessible over the Web.

The technology takes advantage of Kodak Photo CDs and the Kodak IMAGE PAC file-format technologies. The format stores pictures at five different quality levels from low- to high-resolution. The technology provides a significant leap in capability over other online image formats that are now in widespread use. Kodak Photo CD technology, implemented with their NCSA partnership, supports full 24-bit color with color management, allowing users to work with photorealistic images. Now users will be able to interactively crop and enlarge pictures, rotate them, and zoom in to see fine details of images available online.

"Through a longstanding relationship, Kodak and NCSA scientists have combined their respective technological strengths in digital science and massively parallel computing to provide Internet users with a more powerful way to access high-quality images and explore them in new ways," said James W. Meyer, Kodak senior vice president, director of Research and Development, and chief technical officer. "The NCSA Industrial Grand Challenge Award confirms our long-held belief at Kodak that technology must be customer focused, delivering novel ways for people to use and enjoy pictures."

"The foundation for this award began 10 years ago when Kodak became our first industrial partner," said John Stevenson, NCSA corporate officer and head of the Industrial Program. "Their researchers have been constant leaders in exploring the benefits of the evolving, leading-edge, high-performance computing and communications technologies. The company's top management commitment, combined with the personal initiative of Terry Lund and his team, have led to this significant competitive advancement."

Kodak is a world leader in developing, manufacturing, and marketing photographic and imaging products. More information is available via Kodak's Web site at the URL at left. ●

Kodak http://www.kodak.com/

Industrial Grand Challenge Awards http://www.ncsa.uiuc.edu/IndusProg/IGPCawards.html

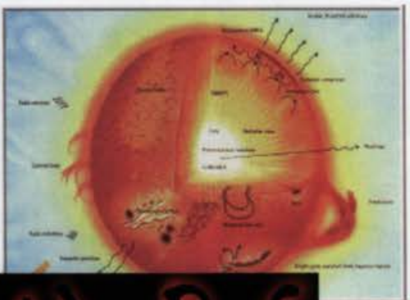


Wilmer Zehr

At the Eighth Annual Executive Meeting in May, partner executives and NCSA staff convened at the Beckman Institute to discuss state-of-the-art developments in information systems technology and advanced computing and their relationship to U.S. businesses in today's global marketplace. In his keynote address to the group, entitled "Prototyping the Corporate Intranet," NCSA Director Larry Smarr recognized the many benefits to the center that have resulted from the Industrial Program. Such benefits ranged from seed funds for new R&D to valuable feedback and advice regarding NCSA's enterprise. Smarr concluded, "The opportunities [in HPCC] are stronger than they've ever been."

NCSA/UIUC Collaboration: UIUC Astronomy Students Encounter the Web

by Allison Miller









UIUC Astronomy 100, Section 2 http://www.astro.uiuc.edu/astr100/section2/

"The purpose of this assignment is for you to begin to create your home page. Everyone gets full credit for 'just showing up' in cyberspace by the due date of this exploration."

Does this sound like any undergraduate assignment you remember? Maybe not, but it does ring a bell with the students who enrolled in the spring semester of Astronomy 100, Section 2. This assignment was given as part of a Web Explorations project to the approximately 200 students of Michael Norman, NCSA senior research scientist and UIUC professor in astronomy.

The Web as a resource

One of Norman's primary goals is to get his students excited about the subject of astronomy. Norman's secondary goal is to expose his students to the World Wide Web and to introduce them to using the Web as an educational resource. Umesh Thakkar, program coordinator of science education in NCSA's Education and Outreach Division, was enlisted to help reach this goal.

"The motivation [for using the Web] comes from two directions," says Norman. "One is that it is almost a mandate from the administration to use Web-based learning in education. I also realize that in astronomy there is an enormous amount of material on the Web, probably more than in any other field. That is because astronomy has been a digital science for at least a decade. So I knew that there was a lot out there, and I wanted to expose the students to those resources."

Exploring the Web

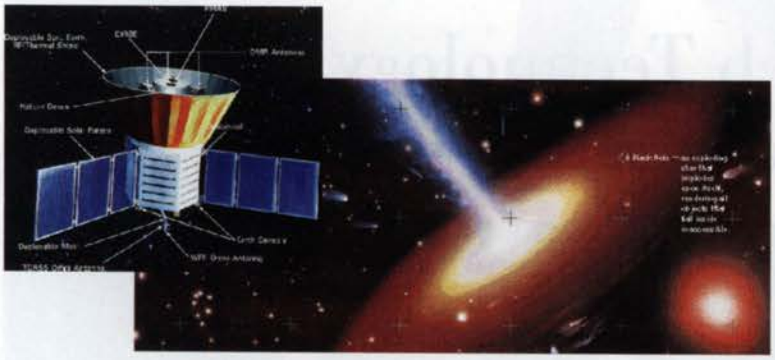
Norman has incorporated into his curriculum a section called Web Explorations in which students are encouraged to explore some facet of astronomy. The explorations are meant to give students first-hand experience rather than second-hand information. Students individually explore the World Wide Web's astronomical sites, construct personal Web pages, and build a Web-based group project.



Tony Baylis, NCSA

Left to right: Jodi Asbell-Clarke, TERC; Pam Van Walleghan, Urbana Middle School; Vivian Hoette, Adler Planetarium; Mike Norman, NCSA/UIUC; and Umesh Thakkar, NCSA

Web images Astronomy 100, Section 2 Web Site



"Curriculum drives the use of technology in classrooms. If the Web can enhance student learning or classroom instruction, then its use should be explored," says Thakkar. "Much astronomy information is available on the Web, so it was a natural for this approach."

Moving onto the Web

Before the first Web Explorations assignment was given, Norman surveyed the students to discover their previous experience with the Web. Of the 178 students replying to the survey, 96% actively used email, while 63% had been on the World Wide Web before. The first project required that all students in the course go online to create their own Web pages. Although the composition of the pages vary from complex HTML (Hypertext Markup Language) to reconstructions of the simple class model, the achievement is the same. All the students—some of whom knew little about the Web before the assignment—now have their own creations online. See the URL on the opposite page.

"The first assignment was to create a Web page, and the students did that sort of kicking and screaming," says Norman. "But once they learned how to do it, the majority of them felt empowered by the experience. They had heard about the Web. In fact more than half of them had used the Web, but they had no idea how to create their own Web pages. This gave them an excuse to learn."

Interacting on the Web

"Web Explorations began with Dr. Norman providing the students in the classrooms with an appetizer on modern astronomy via the Web," says Thakkar. "The assignment was very simple and our goal was very modest—to get students interested in the Web. He has an extensive background in computing and astronomy, and the Web seemed the ideal vehicle to showcase to students. For instance new planets had been discovered by two astronomers at San Francisco State University. Dr. Norman showed their site on the Web and talked about it. He used the Web in a very effective manner to get students motivated."

"The Web's popularity is growing," adds Thakkar. "We are moving ahead from just browsing to interactivity on the Web for student-directed learning. Of course it is usually easy for engineering and science students. They generally have a computing background. There needs to be an effort to provide opportunities to nonscience majors in the use and practice of the World Wide Web to prepare them for the future." ●

Allison Miller, former student intern in the NCSA Marketing Communications Division, recently graduated from UIUC with a B.A. in rhetoric. She was awarded the Kerker Quinn Award for Creative Writing by the UIUC Department of Rhetoric.

Hands-On Universe Enables Astronomical Exploration

by Fran Bond

A recent lecture/demonstration of Hands-On Universe (HOU), an educational project for high school students learning astronomy, was sponsored by NCSA's Resource for Science Education (RSE) program with guidance from NCSA senior research scientist Michael Norman (see article left).

Via the World Wide Web, HOU links classrooms to automated telescopes at professional observatories. Students are able to download images or request new observations. They use HOU-IP—a Windows- and Macintosh-based image-processing software program developed specifically for high school students—to manipulate and analyze images. HOU follows standards set down by national agencies for implementation and teacher support.



Tony Baylis, NCSA

Jodi Asbell-Clarke

Jodi Asbell-Clarke introduced the HOU project to about 20 local teachers and spoke to Norman's Astronomy 100 class. Asbell-Clarke develops HOU curriculum units working through TERC, a private, nonprofit education organization in Cambridge, MA. (TERC is a research and development organization that has a commitment to improve mathematics and science learning and teaching.)

HOU is funded by Lawrence Berkeley Laboratories, Berkeley, CA. Carl Pennypacker, a Lawrence Berkeley cosmologist, developed the program out of his research to help reform science education. NSF and the Department of Energy also support the program.

Currently used in approximately 30 high schools around the nation, the goal is to expand to as many as 700 sites in middle schools and informal education centers, such as museums. This year it is anticipated that 120 new sites will use HOU.

For more information, including HOU workshops at NCSA and other locales, see the Web site at right.

Fran Bond is an editor in the NCSA Publications Group.

Hands-On Universe http://hou.lbl.gov/

*Chick*Scope: Web Technology Delivers Miracle of Embryonic Discovery

by Jim Barlow



Beckman Visualization Lab

Via the Web and MRI, students saw chicks hatch over 21 days. Some examples shown, reading from left to right above, were Day 2, Day 12, and Day 17. Parts of the developing chicks, see callouts, were unclear to the researchers.

At first glance scientists struggling with the images on a computer screen at the UIUC Beckman Institute for Advanced Science and Technology this spring could have been mistaken for astrophysicists speculating about a newly discovered neutron star.

Their questions were basic: "What are we looking at?" "Has this ever been seen before?" Answers such as "I don't really know" and "Not according to the literature" deepened the mystery. A white spot on one image heightened their speculation.

The scientists were looking at an early stage of life—not at x-ray pulses emitted by a dying star. The mystery image was a 5-day-old embryo inside a chicken egg. It was being viewed for the first time by magnetic resonance imaging (MRI) at UIUC. The white spot, they speculated, perhaps was the chick's heart.

The excitement of scientific discovery was clear as Clint Potter and Carl Gregory, both researchers at the Beckman Institute and NCSA, met with Jo Ann Eurell, professor of veterinary biosciences in the UIUC College of Veterinary Medicine, to view the chicken egg through the world's first NWebScope server at the UIUC's Biomedical Magnetic Resonance Laboratory (BMRL). The Internet server allows computer users with browsers to link up from anywhere to an MRI machine and do experiments.

The researchers prepared for Project May Day, a 21-day real-time experiment that began April 15 to deliver the miracle of embryonic development via the World Wide Web to primary and secondary schools. Students at Champaign's Countryside School and Central High School, Don Moyer Boys and Girls Club, Urbana's Wiley Elementary School, University Primary School, Urbana's Middle and High Schools, and Teutopolis High School logged onto their computers at specific times each day.

"We hoped to get the students excited about the process of discovery," said project coordinator Potter, who conceived of Project May Day to demonstrate the potential of remote instrument control through standard Web browsers. "The project evolved during the entire month of April as we learned from the students and as we refined our own technique."

The ambitious project involved several researchers as well as Project SEARCH, a UI undergraduate science outreach program; NCSA's Resource for Science Education Program; BMRL; UIUC Beckman Institute; UIUC College of Veterinary Medicine; Champaign County Extension Unit School Enrichment Program; and Illinois Natural History Survey. Chip Bruce, professor in the Department of Curriculum and Instruction in the College of Education, is directing an evaluation of Project May Day.

The students' daily involvement actually helped the scientists in their MRI documentation of the step-by-step development of a chick—considered a good model for overall species development. A chick grows quickly, hatching in 21 days. The chicks in the experiment hatched on May 1, or May Day—hence the project's name.

"Currently there are no reports in the scientific literature of MRI of a developing chick," Eurell said. "We hoped to visualize new information about this process with this study. As MRI technology continues to develop, other species may be followed using this noninvasive procedure."

Previous documentation of chicken development involved destroying eggs at various stages. With MRI, eggs are undisturbed; researchers can capture images at any time. The eggs were kept in an incubator when they were not under observation.

MRI is a noninvasive diagnostic technique that has been used extensively in medicine to view internal parts of the human body. Unlike x-rays or surgery, the high-quality images produced by MRI carry no known risk to patients. The technology in recent years has been extended to a variety of disciplines, from agronomy to food. It allows researchers to study internal dynamics without disturbing processes.

"Children were able to observe the wonder of a chick's development inside the egg, without harming or disturbing it, and college students and research scientists learned more about embryonic development," said BMRL Director Paul C. Lauterbur, a pioneer of MRI technology. "Each profited at the appropriate level by simple observations and by making and testing hypotheses as they controlled the imaging process, using the same developing egg but bringing different levels of knowledge and insights to their experiments. Our laboratory learned how to improve our software and interfaces and our training methods, so as to carry out future research projects more effectively."

Potter and Gregory, who designed the BMRL's server that connected the MRI to the World Wide Web, set up the control parameters that allowed other researchers

BMRL http://bmrl.med.uiuc.edu:8080
ChickScope http://vizlab.beckman.uiuc.edu/chickscope



Umesh Thakkar, NCSA

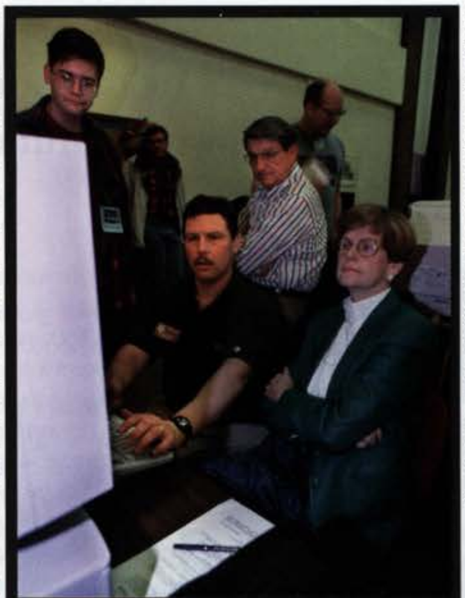
Some chicks were displayed at University Primary School.

and students to view the egg and manipulate their observations effectively. Among the earliest challenges was simply realizing what they were seeing.

"We saw changes not seen before in the yolk and tissues," Eurell said. "We went into this with a great deal of curiosity about what we would see." Eurell's team met with teachers from the participating schools to train them on using their browser software to view the egg and manipulate the MRI images. Each day the students viewed a prepared image to guide them into that day's session. Then they were able to ask their own questions and seek answers. They documented what they did in special online WebNotebooks, called *Chicken Scratchings*, that were designed by Barbara Fossum, director of the Beckman Institute's Visualization Lab.

As with any scientific experiment, there were risks. "This is truly a Web event," Eurell said. As for the newborn chicks, they were adopted by Randy Butler and Jeff Terstriep of NCSA. To explore the project further, see the URLs at the far left. ●

Article courtesy UIUC News Bureau.



Reproduced by permission of *The Champaign-Urbana News-Gazette*, photo by Carlos Miranda

Prairienet representative Brad Cronk (seated left) helps Pat Moore (seated right) sign up for a Prairienet account at the Community Internet Fair. An estimated 800 people took part in the six-hour event that was sponsored by the Champaign County Network (CCNet) of the Champaign County Chamber of Commerce, Parkland College, *The Champaign-Urbana News-Gazette*, and NCSA.

Champaign County http://www.prairienet.org/champco

NCSA's NWebScope Delivers Interactive Real-Time MRI

Interactive, real-time magnetic resonance imaging (MRI) can now be done on the World Wide Web with NWebScope—state-of-the-art instrumentation developed at UIUC. With universally available browser software, researchers anywhere can conduct experiments from their desktop or laptop computers.

The interactive MRI system—known as NmrScope—is available on the Web through NWebScope. NmrScope provides simple on-screen instructions that allow remote users to review and modify experimental conditions for observations of objects in an MRI system. The resulting images are displayed on-screen as soon as they are produced.

Scientists Carl Gregory and Clint Potter of the UI College of Medicine at Urbana-Champaign and NCSA, working at the UIUC Beckman Institute with funding from the Division of Research Resources of the National Institutes of Health, have linked standard commercial MRI system components (manufactured by Surrey Medical Imaging Systems and Magnex Scientific) with an IBM RS/6000 workstation and software produced at the university to create NWebScope.

An authorized researcher, who must first arrange for a sample to be delivered to the university or provided to the university by a nearby collaborator for analysis, can connect to the server by entering its URL in a Web browser. The experimenter then sees a form showing the instrument settings and a menu of possible functions, such as move slice forward, zoom in, zoom out, and so on. After choosing the desired conditions, the researcher clicks a screen button and the experiment is carried out. A resulting image is returned to the screen, allowing immediate decisions on the next steps to be taken, including downloading the image for later analysis.

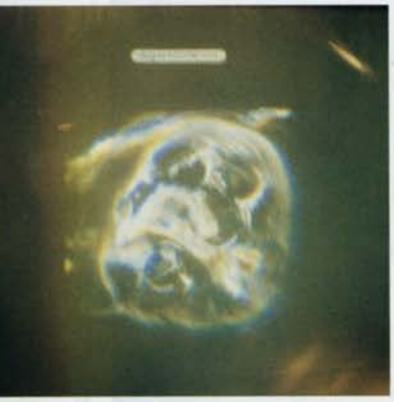
Instead of having to purchase expensive state-of-the-art MRI systems, researchers can use inexpensive browsing software, such as NCSA Mosaic or Netscape Navigator, and pay only the usual usage fee on the MRI system. Additional details can be obtained from the Beckman Magnetic Resonance Laboratory (BMRL) Web site (see URL on the opposite page). ●

Summer Workshops

Workshops for teachers and for K–12 students are offered this summer by NCSA's Education and Outreach Division. See http://www.ncsa.uiuc.edu/edu/classroom/summer96/ for schedules, application forms, and other details.

NCSA Collaborates to Showcase Mummy Visualizations

by Fran Bond



A Roman period Egyptian mummy (carbon dated at about 190 BC, plus or minus 160 years) owned by the UI's World Heritage Museum, UIUC campus, has undergone a series of nondestructive analyses to determine embalming procedures, age, gender, and medical history of the individual inside the wrappings. This interdisciplinary effort involving almost a dozen research teams at the Urbana-Champaign and Chicago campuses—including NCSA's Biological Imaging Group (BIG)—has been ongoing since 1989, the year the mummy was donated to the museum.

Research is coordinated by the Program on Ancient Technologies and Archaeological Materials, one of several UIUC co-organizers for the 30th International Symposium on Archaeometry held on the UIUC campus in May. With the collaboration of the Beckman Visualization Facility and NCSA's BIG, computer visualizations of the UI's mummy were showcased at the UIUC Beckman Institute to some 200 conference delegates from the world's outstanding museum labs.

Clint Potter, team leader of BIG, says that the NCSA group has collaborated in a variety of visualization techniques, including holography and virtual environment visualization. For conference attendees, NCSA Senior Research Programmer Rachael Brady demonstrated visualizations of the mummy dataset using *Crumbs,* volume visualization software for the CAVE [see *access,* Fall 1995, page 26].

Through the archaeological and analytical efforts of the research teams, it has been established that the mummy is a seven- to nine-year-old child of mixed race belonging to the Greco-Roman aristocracy ruling Egypt in the second century AD. The child's gender and cause of death are still to be determined. ●

Fran Bond is an editor in the NCSA Publications Group.



Holographic rendering of the head of the UI's mummy (left) from the Fayum Dynasty. (Computer-generated holography by Michael Dalton, Voxel Inc., obtained from CT dataset.) Stills of a 3D animation of the same head (above right) cyberscanned from a sculpted reconstruction. (Cyberscanning by the UIUC Beckman Visualization Facility under the direction of Barbara Fossum from forensic reconstruction by Ray Evenhouse, UIC Biomedical Visualization Facility.)

Photos Jeff Carpenter, NCSA



Tony Baylis, NCSA

Dick Lampman, director of the Computer Research Center of Hewlett-Packard Laboratories in Palo Alto, CA (left), recently met with Larry Smarr, director of NCSA (right), and others from UIUC/NCSA. Discussions focused on technologies to create intranets and support for NCSA's HP-Convex machines.

Federal Award Grants Include NCSA

by Amy Whitaker

The U.S. Army Information Systems Selection and Acquisition Agency, part of the Department of Defense (DoD), has selected two collaborative teams, both including NCSA, to provide state-of-the-art technology to two of four resource centers planned by the DoD. Awards for the other two resource centers are expected early this summer. NCSA is a member of both proposal teams.

NCSA is part of two university teams that are to provide the Programming Environment and Training (PET) for the centers. The university teams will work with Nichols Research Corporation (NRC) and each site to transfer state-of-the-art technology in a variety of computational technology areas (CTAs) of importance to DoD users.

The DoD initiated the High Performance Computing Modernization Program to bring DoD laboratories to a level comparable to that of the foremost civil and other government research and development agencies. The program focuses on the establishment of four Major Shared Resource Centers (MSRCs) to provide complete high-performance computing environments, support research and development, address computer and computational science, and provide education and training for users across the DoD community.

"This announcement is part of a historic reconvergence of the military and civilian sectors of our country," said NCSA Director Larry Smarr. "NCSA is proud to be an integral part of this process."

On May 1 NRC, a Huntsville, AL-based company that provides information systems and technical services for commercial entities, state governments, DoD, and other federal government clients, signed its second DoD contract for the High Performance Computing Modernization Program at the Aeronautical Systems Center (ASC), Wright-Patterson Air Force Base, Dayton, OH. NRC and its university partners will supply hardware, applications and systems software, maintenance, and support. The contract is initially valued at $53.4 million with options that could increase its value to $157.9 million over its life. It calls for two upgrades to the initially installed systems and operations and maintenance service for eight years.

Six weeks before signing the ASC deal, NRC won an award for the modernization program at the Army Corps of Engineers' Waterways Experiment Station (CEWES) in Vicksburg, MS. That contract awarded NRC $42.2 million and could increase to $155.5 million over its eight-year life. It includes modernization of high-performance computing equipment and services at CEWES in support of defense department scientists and engineers across the nation.

"NCSA is looking forward to working with the DoD user community in building an advanced environment that will support workshops, training, and collaborative activity to maximize return on DoD's investment in the MSRCs," said Melanie Loots, associate director of NCSA's Applications Division. "While NCSA will be focused on the information technology transfer center, visualization, structural engineering, and nanoelectronics, NCSA will also participate in activities that cut across all computational technology areas."

Ohio State University leads the PET team at the ASC site. Jeff Huskamp will be directing the project during the introductory phases. Mississippi State University, under the direction of Joe Thompson, serves as the academic lead at the CEWES site. At both sites NCSA leads the information/communication transfer center and the scientific visualization and computational structural mechanics technology transfer centers (TTC). NCSA also leads the computational electronics and nanoelectronics TTC at the ASC site.

"I am excited to be coordinating the NCSA participation in this multiyear program and to see innovative opportunities for technology development by NCSA researchers supporting this partnership," said John Ziebarth, associate director of NCSA's Education and Outreach Division. "As the nation enters the twenty-first century, computation and information technology will increasingly play a major role in advancements in all areas of science and engineering. Scientists and engineers across the nation, working with the DOD, can now expect to have the resources they will need to maintain the United States' global leadership."

The leads of the other TTCs at the ASC site are Mississippi State University in computational fluid dynamics; Ohio State University in computational chemistry and materials science, computational electromagnetics and acoustics, and climate, weather, and oceans; Syracuse University in forces modeling and simulation; and the Center for Research on Parallel Computation (CRPC) at Rice University in programming tools/emerging systems. At the CEWES site, the leads are Mississippi State University in computational fluid dynamics; CRPC in programming tools; Syracuse University in forces modeling and simulation; and Ohio State University in climate, weather, and oceans.

There is a focus on working with historically black colleges and universities and minority institutions led by Central State University at the ASC site and Jackson State University at the CEWES site.

These selections are two of four planned by the DoD. The DoD also plans to set up high-performance computer centers at the Naval Oceanographic Office at Stennis Space Center in Gulfport, LA, and at the Aviation Research Lab at the Army Research Lab in Aberdeen, MD. ●

Amy Whitaker, student intern in the NCSA Marketing Communications Group, contributed to this article. She recently won the Lulu Kelly Nardine Scholarship for excellence in writing from UIUC's College of Communications.

Nichols Research Company http://www.nichols.com

Short Animation Wins Acclaim

the end, a six-minute computer-generated animation created with technology developed at NCSA and SGI, is continuing to receive critical acclaim after being nominated for an Oscar by the Academy of Motion Picture Arts and Sciences.

The animation, created by Chris Landreth and Robin Bargar, was one of five nominations for an Academy Award in the Best Short Film (animated) category and the only one utilizing computer graphics. Landreth—computer animator and artist-in-residence at Alias/Wavefront, Toronto-based subsidiary of Silicon Graphics Inc.—designed and created the animation. Bargar, who composed and computed the sound, is director of NCSA's Audio Development Group, part of the Virtual Environments Graphics Division. Both artists collaborated on the script and storyboard.

Produced by Alias/Wavefront, the animation utilized Alias PowerAnimator software to create the graphics. Sound was rendered with NCSA Sound Server and other software. The software empowered the artists to structure an interactive creative process where sound and image computation were brought together at every stage of production. "A prime objective was to elevate the role of sound in the decision-making process," said Bargar. "To this end special software was created to allow data-sharing between the animation and sound synthesis processes."

Both artists used SGI high-performance workstations. Landreth used Indys and Indigo2 Extremes for modeling and animation; Indys, Indigo2s, Onyxes, and a POWER CHALLENGE, for rendering. Sounds computed at NCSA ran on Indys and Indigo2s.

Although Bargar and Landreth did not expect to win the Academy Award due to competitors like Walt Disney, they won three prizes at Imagina, the prestigious annual international computer graphics festival in Monaco—a 3D animation award at PIXEL-INA Awards, a special award from the judges; a third-place award in the Fiction category, after *Toy Story* and *The Simpsons;* and an international award of the SACD (Societe des Auteurs Compositeurs Dramatiques) for the scenario, granted for excellent narrative structure. Without NCSA's promotion of collaboration between art, science, and technology, Bargar said *the end* could not have been made. ●

Amy Whitaker, student intern in the NCSA Marketing Communications Division, contributed to this article. She recently won the Lulu Kelly Nardine Scholarship for excellence in writing from UIUC's College of Communications.

1995 Academy Award nominees http://oscars.guide.com/nominees/category

***the end* animation demonstration** http://www.aw.sgi.com:80/Feature/the_end.html

Butler Is a Top Federal Employee

by Allison Miller

For the past seven years, *Federal Computer Week*'s Federal 100 Award has been presented annually to 100 executives from government, industry, and academia. An independent panel of judges selects those who have the greatest impact on the government systems community in the previous year.

For 1995 this prestigious honor was awarded to Michelle Butler, research programmer in NCSA's Computing and Communications Division (C&C), to recognize her leadership and hard work on the Electronic Town Meeting project (May 1–14, 1995). Butler helped design a scalable architecture to withstand the expected load of the national project, and she supported the system throughout the meeting.

A project of Vice President Al Gore's office, the Electronic Town Meeting sought to gather public opinion on the use of information technology by federal, state, tribal, and local governments to create an electronic government. The open meeting was conducted in cyberspace via national electronic networks. Those without electronic connections could participate at Public Access Sites—public and private organizations volunteering their facilities without charge.



Courtesy Federal Computer Week

Michelle Butler

NCSA took part in producing an open forum on the subject of "People and Their Governments in the Information Age," the nation's first experiment using computing and communications technologies to engage citizens in participatory democracy.

Initially NCSA got involved with the project to act as a backup site if the federal site failed. As the expected load grew to include almost everyone in the nation, NCSA, SDSC, and the federal systems group became partners in sharing the meeting load.

"To do this," said Butler, "all sites had to read and update the same file system simultaneously—that meant using a distributed file system." The meeting used NCSA's Andrew File System servers for the file system, and NCSA's round-robin Domain Name Service (DNS) [see *access*, Spring 1995, page 18] to share the load among the three systems. NCSA's DNS server was used for the entire meeting.

"Among other responsiblities Michelle helped build a system that would handle the tremendous load associated with such a large-scale project. Michelle also kept her normal responsibilities at NCSA, working many extra hours to help the Electronic Town Meeting team," said Charlie Catlett, associate director for C&C.

Butler was recognized in a special supplement to the March 18 issue of *Federal Computer Week* and on April 2 went to a banquet in Washington, DC, to receive the award. "I was quite surprised and overwhelmed by all the nice notes and attention that I received," said Butler. "A lot of NCSA teamwork contributed to this project. It wasn't just me. But this is the way C&C works. Everyone pulls together to help each other." ●

Allison Miller, former student intern in the NCSA Marketing Communications Division, recently graduated from UIUC with a B.A. in rhetoric. She was awarded the Kerker Quinn Award for Creative Writing by the UIUC Department of Rhetoric.

For Further Information

Documentation Orders

Articles in this *access* may refer to items that are available through the *NCSA Technical Resources Catalog*. To receive a hard copy of the catalog, send your request to Orders for Publications, NCSA Software, and Multimedia [see NCSA Contacts, inside front cover]. To view the catalog online, access the URL: http://www.ncsa.uiuc.edu/Pubs/TechResCatalog/TRC.TOC.html. To obtain the catalog from anonymous ftp, see instructions below. The catalog is in the /ncsapubs/TechResCatalog directory.

Accessing NCSA's Servers

Many NCSA publications (e.g., calendar of events, user guides, *access*, technical reports) as well as software are available via the Internet on one of two NCSA servers: anonymous FTP or the World Wide Web. If you are connected to the Internet, we encourage you to take advantage of the easy-to-use servers to copy or view files.

Anonymous FTP address:	ftp.ncsa.uiuc.edu
NCSA WWW Home Page:	http://www.ncsa.uiuc.edu/

NOTE: References in *access* to a URL refer to the server address and file location information used by Web-browser software to retrieve documents.

If you have any questions about accessing the servers, contact your local system administrator or network expert. Instructions for accessing the anonymous FTP server follow.

Downloading from Anonymous FTP Server

A number of NCSA publications are installed on the NCSA anonymous FTP server. If you are connected to the Internet, you can download NCSA publications by following the procedures below. If you have any questions regarding the connection or procedure, consult your local system administrator or network expert.

1. Log on to a host at your site that is connected to the Internet and running software supporting the ftp command.
2. Invoke FTP by entering the ftp command and the Internet address of the server: `ftp ftp.ncsa.uiuc.edu`
3. Log on using `anonymous` for the name.
4. Enter your local login name and address (e.g., smith@ncsa.uiuc.edu) for the password.
5. Enter `get README.FIRST` to transfer the ASCII instruction to your local host.
6. Enter `quit` to exit FTP and return to your local host.
7. The NCSA publications are located in the `/ncsapubs` directory.

general abbreviations

CTC	**Cornell Theory Center**
DARPA	**Defense Advanced Research Projects Agency**
EVL	**Electronic Visualization Laboratory**
HPCC	**High Performance Computing and Communications**
NASA	**National Aeronautics and Space Administration**
NCAR	**National Center for Atmospheric Research**
NCSA	**National Center for Supercomputing Applications**
NII	**National Information Infrastructure**
NSF	**National Science Foundation**
PSC	**Pittsburgh Supercomputing Center**
SDSC	**San Diego Supercomputer Center**
SGI	**Silicon Graphics Inc.**
TMC	**Thinking Machines Corp.**
UIC	**University of Illinois at Chicago**
UIUC	**University of Illinois at Urbana-Champaign**
URL	**Uniform Resource Locator**
VR	**Virtual Reality**
Web	**World Wide Web**

NCSA abbreviations

Apps	**Applications Division**
CAVE	**Cave Automatic Virtual Environment**
C&C	**Computing and Communications Division**
E&O	**Education and Outreach Division**
F&A	**Finance and Administration Division**
IP	**Industrial Program**
MarComm	**Marketing Communications Division**
SDD	**Software Development Division**
VEG	**Virtual Environments Graphics Division**



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